APPROACHES TO REDUCING POTENTIALLY AVOIDABLE HOSPITAL UTILIZATION IN MARYLAND: EXAMINING THE HEALTH ENTERPRISE ZONE INITIATIVE AND CRISP ENCOUNTER NOTIFICATION SERVICE

by
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Abstract

This dissertation examines two programs that aim to reduce potentially avoidable hospital use: the Health Enterprise Zone (HEZ) Initiative and the Encounter Notification Service (ENS). Potentially avoidable utilization (PAU) is defined as hospital care for ambulatory care sensitive conditions that could have been prevented through the provision of timely and effective care. The HEZ Initiative is a four-year community based intervention implemented in Maryland to improve access to care and ENS is a health information technology tool that can trigger important care coordination activities.

The objectives of this dissertation are to: 1) examine the association between the HEZ Initiative and inpatient and emergency department utilization for seven targeted ambulatory care sensitive conditions; 2) examine the association between the HEZ Initiative and inpatient and emergency department utilization for the Medicaid population; and 3) describe the adoption and use of ENS in Maryland and Washington, D.C.

In a longitudinal study, manuscript one examines the association between the implementation of a four-year community based intervention, the HEZ Initiative, and changes inpatient and emergency department (ED) use for seven ambulatory care sensitive conditions. The HEZ Initiative was associated with a decrease in inpatient discharges related to cardiovascular conditions and diabetes; and an increase in utilization related to inpatient and ED pediatric asthma, certain inpatient behavioral health conditions.

Manuscript two examines the association between the HEZ Initiative and hospital use for the Medicaid population in Maryland over time – specifically measuring changes in total inpatient and emergency department discharges as discharges for ambulatory care sensitive

conditions using a Prevention Quality Indicator composite measure and a HEZ condition composite measure. Among the Medicaid population, the HEZ Initiative was associated with an overall decrease in inpatient discharges and increase in ED visits.

Manuscript three is a descriptive study of the adoption and use of ENS over two years, examining the demographics of patients for whom notifications were sent as well as describing the use and preferences for care entities that adopt the technology. The study found that ENS was adopted at a growing rate and that a wide range of organizations received ENS notifications.

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CHAPTER ONE: INTRODUCTION

Rationale for Research

Many policies, payment systems, and programs have been implemented in Maryland in order to improve care delivery and health outcomes and to reduce potentially avoidable hospital use. One example is Maryland's All-Payer Model - under this model, all health care payers pay the same rates to hospitals.[1,2] The goal of the All-Payer Model is to improve the quality of care and reduce spending for Maryland residents.[2] In addition, in 2014, Maryland implemented a global budget payment program where all payers pay hospitals a fixed amount on an annual basis for both inpatient and outpatient services - regardless of hospital utilization and adjusted for quality of care.[1] The hospital global budget model requires hospitals in Maryland to move away from the traditional fee-for-service payment model towards value-based payment arrangements over a five-year period.[1]

This dissertation will examine two programs in Maryland that have the potential to positively impact health and reduce potentially avoidable hospital utilization: the Maryland Health Enterprise Zone (HEZ) Initiative and the Encounter Notification Service (ENS). The Maryland Health Services Cost Review Commission (HSCRC) defines potentially avoidable utilization (PAU) as hospital care that is unplanned and preventable through improved care, care coordination or community based care.[3] The Agency for Healthcare Research and Quality (AHRQ) describes PAU as hospitalizations due to ambulatory care-sensitive conditions that could be prevented if ambulatory care is provided in manner that is timely and effective.[4] Although HEZ and ENS are quite different – HEZ is a community based initiative that improves access to care and ENS is a type of health information technology (HIT) – but both can improve health outcomes by supporting care coordination and care transition activities.

HEZ and ENS are similar in that one objective of both programs is to improve care coordination in Maryland – the HEZ invests directly in care coordination, provides a foundation for collaboration among health care and community service providers, and also offers resources to train and deploy community health workers. ENS is an admission, discharge, transfer (ADT) alert program that works through the states health information exchange, the Chesapeake Regional Information System for our Patients (CRISP) to trigger care coordination activities by alerting providers of a patient's care event. ENS can send alerts to primary care providers, specialists, but also community service providers. ENS is a tool that can be, and currently is being, used by programs such as HEZ to coordinate patients who receive care or treatment at multiple health or community service sites.

HEZ - Reducing Health Disparities through the Coordination of Health Care and Community Services

The Maryland Health Improvement and Disparities Reduction Act of 2012 acknowledged that, "health disparities are the result of modifiable health care system factors, community factors and individual factors."[5] Health disparities continue to be a concerning problem in the United States – lower-income residents and minorities experience an overall higher rate of morbidity and mortality due to preventable and manageable conditions compared to higher income individuals and non-Hispanic whites.[6,7] Due to the range of factors that impact health disparities, efforts to reduce disparities in access to care and health outcomes must be multifaceted. An important approach to improve the health of underserved populations is by coordinating care and collaborating across health care and community service providers to target the social determinants of health. For individuals with complex conditions or comorbidities, care often needs to be coordinated across primary and specialty care sites, but also with community and

social service providers. Coordinating and collaborating with community service providers, such as health educators, substance use disorder counselors, and mental health specialists, is essential because these providers help target the social determinants of health.

Social determinants of health such as lifestyle, environmental contacts, nutrition, education, and housing must be addressed when efforts are made to improve the health of a community and reduce health disparities.[8-11] It is well established that a larger share of health is due to social, environmental and behavioral factors than it is to genetics or the provision of health care.[8] Figure 1 is a conceptual framework developed by the National Academies of Sciences, Engineering and Medicine (the National Academies) to illustrate the relationship between social risk factors and health care use and outcomes.[12] Vulnerable populations and high utilizers of care often seek care from multiple places and may not have the resources or support to effectively manage or coordinate their care. Improving care coordination and care transitions are important because nearly half of health care related communication errors occur during the transition of patients from one care setting to another.[13]

Health Enterprise Zone Initiative: Building Relationships and Investing in Communities

The HEZ is a community-based intervention implemented in five communities in Maryland from 2013-2017. HEZ was conceptualized and implemented by the State of Maryland in response to the alarming health disparities in the State. In 2012, a year before HEZ implementation began, the Maryland Health Improvement and Disparities Reduction Act of 2012 reported that although Maryland had the 3rd highest median household income and 2nd highest number of primary care providers among the 50 US states, the state also experienced a wide range of health disparities.[5] In 2012, Maryland ranked 28th in obesity prevalence, 31st in diabetes prevalence, 35th in cardiovascular deaths, 33rd in geographic health disparities and had significant

disparities in health care and health outcomes.[5] Within Maryland, health disparities exist in urban, suburban, and rural communities and communities with significant health disparities also frequently experience shortages in primary care workforce.[5]

The HEZ initiative was created to target all these factors as well as the social determinants of health with each of the five HEZs tailoring the program to meet the needs of its community. The structure of HEZ is similar to other interventions that have found that in order the address social determinants of health, it is necessary to: establish cross-sector partnerships, build data systems that bridge health and community services, develop a workforce to deliver interventions to underserved populations [14] In addition to improving care coordination, HEZ activities included: attracting and training health care providers; establishing primary care and specialty care practices; providing transportation for residents in rural communities, and offering screening, medication management and health education services to HEZ community members.

The HEZ initiative also focused on helping individuals with complex health needs navigate multiple care and community resource settings. Often, the patients who are most affected by poor care coordination are patients who have chronic conditions as they must navigate the complex health care system and visit multiple providers.[15,16] Chapter 2 will examine the association between HEZ implementation and inpatient and ED utilization for mental health and substance use disorders (M/SUDs) and for the chronic conditions: cardiovascular disease, diabetes, and asthma.

In addition, the lack of care coordination and poor access to care can lead to inappropriate system utilization – uninsured patients or those with Medicaid or Medicare are 60% more likely, compared to patients with private insurance, to go to the ED for follow-up care instead of going to an outpatient setting.[17,18] Chapter 3 assesses the impact of HEZ on the Medicaid population by

examining changes in inpatient and ED utilization specifically for Medicaid beneficiaries. This study uses two composite measures to evaluate health outcomes: the first "HEZ condition composite measure" combines the targeted HEZ conditions, and the second "Prevention Quality Indicator (PQI) composite measure" is a well-established indicator of changes in utilization for ambulatory care sensitive conditions.

Encounter Notification Service: Use of Admission, Discharge and Transfer alert systems

ENS is an ADT alert program that was implemented in Maryland in 2012 to address the lack of an effective system of sharing patient hospital utilization information across providers. An ENS notification or alert is an electronic message triggered from a hospital's electronic medial record and sent, through CRISP, to a subscribing care organization when their patient is admitted to or discharged from the hospital's inpatient facility or ED. As of November 2015, all 48 hospitals in Maryland had the capability of sending an ENS alert. An ADT alert system provides valuable information for the care transition of a patient – particularly between the acute care setting and ambulatory care setting.[19]

Traditionally, primary care practices have not been informed of their patients' hospitalizations or ED visits in a timely manner, or at all.[16] A literature review of information exchange between acute hospitals and PCPs conducted by Kripalani et al. found that only 17% to 20% of PCP practices were notified that their patients had been discharged from the hospital, and fewer than 20% had received a discharge summary one week post index discharge.[20] Furthermore, of the discharge summaries that were sent, 25% never reached the intended PCP, 38% did not include laboratory results and 21% did not list discharge medications.[20] Coordination of care is particularly important when patients are transitioned from an inpatient setting to an outpatient setting. A study examining the association between PCP knowledge and

post-discharge problems found that 67% of patients whose PCP was not aware of their hospitalizations reported post-discharge problems compared to 32% of patients whose PCPs were aware of their hospitalizations.[21] A wide range of entities, including ambulatory care providers and substance use disorder centers, can subscribe to receive ENS alerts. Chapter 4 is a descriptive study of ENS adoption in Maryland and Washington D.C. and looks at: the demographics of patients for whom notifications have been sent, the alert preferences of care entities that have subscribed to ENS, and the characteristics of the ENS notifications that have been sent during the study period.

Study Aims

This dissertation has three aims:

Aim 1: To examine the association between implementation of the HEZ Initiative and changes in inpatient stays and emergency department (ED) visits for cardiovascular disease, diabetes, asthma/COPD, pediatric asthma, and mental health and substance use disorders.

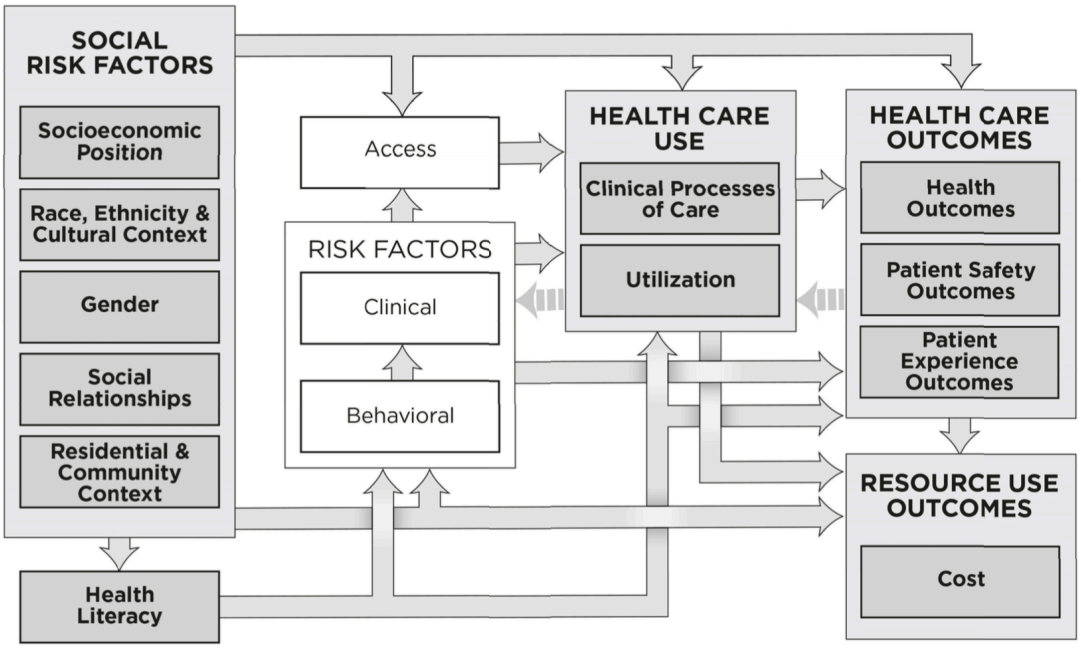
Aim 2: To examine the association between implementation of the HEZ Initiative and changes in inpatient stays and ED visits for the Medicaid population, specifically examining: HEZ condition composite measure, and Agency for Health Quality Research (AHRQ) Prevention Quality Indicator (PQI) composite measure.

Aim 3: A descriptive study of the adoption of ENS in Maryland and Washington, D.C. from 2013 to 2015.

Dissertation Organization

Chapters 2-4 of this dissertation include the three manuscripts. Chapter 5 is the concluding chapter that summarizes the findings and discusses policy implications and areas for future research.

Figure 1.1. Conceptual framework of social risk factors for health care use, outcomes and cost.[12]



* Source: National Academies of Sciences, Engineering and Medicine

CHAPTER TWO: MANUSCRIPT ONE

The Impact of the Community-Based HEZ Intervention on Hospital Utilization for Targeted Conditions

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Abstract

Background: The HEZ Initiative is a four-year community-based intervention implemented in five underserved communities in Maryland in 2013. The HEZ supports collaboration among health and social service organizations to: reduce health disparities among racial and ethnic minority populations and among geographic areas; improve health care access and health outcomes in communities; and reduce health care costs and hospital admissions and readmissions.

Objective: To examine the association between the HEZ intervention and inpatient and emergency department (ED) utilization for cardiovascular conditions, diabetes, asthma and mental health and substance use disorders.

Methods: This quasi-experimental pre-post study includes eight years of Maryland hospital utilization data from 2009 to 2016. The study compares per capita outcomes for individuals who utilized care and reside in either one of the 16 zip codes that are part of the five HEZ communities or one of the 94 zip codes that were eligible for HEZ but were not part of the initiative. The study design was difference-in-differences.

Results: The study included 344,744 inpatient stays and 1,241,190 ED visits in the HEZ zip codes, and 2,324,687 inpatient stays and 6,774,361 ED visits from the HEZ eligible groups over the eight-year study period. The HEZ intervention was associated with a decrease of 0.79 inpatient cardiovascular discharges per 1,000 (95% CI, -1.19 to -0.40; P <0.001) and a decrease of 0.39 inpatient diabetes discharges per 1,000 (95% CI, -0.65 to -0.13; P <0.01). However, the HEZ intervention was also associated with an increase in per capita inpatient discharges for asthma, pediatric asthma, substance use disorders, depression and emergency department visits for pediatric asthma.

Conclusion: This study found that the HEZ intervention activities were associated with a decrease in inpatient utilization for individuals with cardiovascular disease and diabetes, but an increase in inpatient utilization for asthma, pediatric asthma and certain M/SUD conditions as well as emergency department visits for pediatric asthma. The impact of the intervention may take longer to reduce utilization for those conditions, or it is possible health education and screening increased the decision for residents with those conditions to seek care in an inpatient setting.

Introduction

The Health Enterprise Zone (HEZ) Initiative is a four-year community based multicomponent intervention implemented in Maryland in 2013. The program was jointly administered by the Community Health Resource Commission (CHRC) and the Maryland Department of Mental Hygiene (DHMH) with an annual budget of $4 million.[22] Broadly, the purpose of the HEZ Initiative is to focus resources that can modify determinants to specifically: reduce health disparities among racial and ethnic minority populations and among geographic areas; improve health care access and health outcomes in underserved communities; and reduce health care costs and hospital admissions and readmissions.[23]

As part of the initiative, five Health Enterprise Zone communities - or "HEZs" - were selected and received funding and technical support to implement their specific intervention activities. The five HEZs that were selected are Annapolis/Morris Blum (Annapolis), Caroline and Dorchester Counties, Capital Heights in Prince George's County (Prince George's), Greater Lexington Park in St. Mary's Country (St. Mary's), and West Baltimore in Baltimore City (West Baltimore). Figure 2.1 displays where these HEZs are geographically located within Maryland. These five HEZs vary in population size and include rural, suburban and urban communities providing examples of how the HEZ Initiative can be implemented in a variety of settings. Each HEZ developed their own approach and strategies to address the most pressing needs in their communities.

Overall, the HEZ Initiative provided communities with the resources to:

- Improve care coordination and care transition
- Collaborate across health service and community service agencies
- Attract and train health care providers and community health workers

- Establish Patient Centered Medical Homes, primary care practices and specialty care practices
- Provide screening, medication management and health education services to HEZ community members
- Identify and manage high utilizers of care
- Provide transportation services in rural communities

This longitudinal study will focus on how the implementation of HEZ has impacted hospital use for "HEZ targeted" conditions. These are ambulatory care sensitive conditions that at least one of the five HEZ chose to focus on were based on the needs of the community.[23] The seven HEZ conditions include the chronic conditions cardiovascular disease, diabetes, asthma, pediatric asthma; as well as mental and substance use disorders (M/SUDs). As with many health conditions, all of the HEZ conditions benefit from coordination of services beyond a health care setting.

Bridging the gap between health and community services

HEZ was conceptualized and implemented to fill a need in the community and to address the root cause of health disparities in part by connecting health services and community services. Most public funding goes to acute medical care instead of investments in upstream social and environmental determinants of health.[8,14,24] Some estimate that 95% of the trillion dollars spent on health care in the US goes to direct medical services even though there is evidence that 60% of preventable deaths are rooted in modifiable behaviors and exposures that occur at the community level.[10,14]

In order to reduce health disparities in the state, the HEZ purposefully targeted underserved communities. On a national level, studies have shown that if the rate of potentially

avoidable hospitalizations among residents in low-income communities was reduced to the level among residents in high-income communities, there would be 500,000 fewer hospitalizations annually.[14] There is evidence that partnership and collaboration among health services, social services, public health and community-based organizations can improve population health and reduce potentially avoidable hospitalization.[14,25] In addition, studies have shown that linking high utilizers to social services can improve health outcomes and reduce costs.[14] Unfortunately, most health systems, particularly those in underserved areas, do not have the infrastructure nor the incentives to build relationships and coordinate care with the multitude of community service providers that would be required to address the health-related social needs of their patients.[14] Therefore programs such as HEZ, which directly fund such collaborative efforts, are essential.

There has been widespread recognition that community-based interventions like the HEZ Initiative can improve the health of populations. In 2017 CMS initiated a 5-year, $157 million Accountable Health Communities (AHC) program.[14,26] The AHC program was created due to evidence that it was possible to improve health outcomes and reduce cost by addressing health-related social needs through the linkage of health services providers and community organizations.[27] Similar to the HEZ, the goal of the AHC is to build capacity within a community in order to address the health related needs of a geographically defined population.[14] Specifically, the program will assess if identifying and addressing health-related social needs can reduce health care utilization and cost for Medicare and Medicaid beneficiaries. In addition, like the HEZ Initiative, the AHC model includes "bridge organizations" that have strong relationships with clinical and community partners. Examples of bridge organizations include: community organizations, local health departments, managed-care organizations and clinical networks.

In addition to the AHC model, other initiatives that have implemented programs similar to HEZ include Hennepin Health[28] in Minnesota, as well as Community Health Programs[29] that have been implemented in eight states. However, all of the programs previously mentioned differ from HEZ because they all provided care to Medicare and/or Medicaid beneficiaries whereas HEZ does not limit services to community residents based on insurance type or ability to pay.

Developing HEZ and Selecting the Five Communities

In order to target long standing health disparities in Maryland, Maryland Lt. Governor Anthony G. Brown assembled the Maryland Health Quality and Cost Council's Health Disparities Workgroup to discuss strategies to reduce health disparities.[23] This workgroup identified social determinants of health that were responsive to community intervention and also recognized that emergency department (ED) visits and hospital admissions for ambulatory-care sensitive conditions were health outcomes that could be used to measure the impact of a community intervention.[23] The concept behind HEZ was to saturate underserved communities with primary care providers and other health care services and to improve coordination among health and community service providers.

The recommendations of the Workgroup became legislation through the Maryland Health Improvement and Disparities Reduction Act of 2012 which created the policy framework for the HEZ.[23] The HEZs were selected through a competitive application process. In order to be eligible to apply, a potential HEZ needed to be a contiguous geographic area with measurable and documented economic disadvantage and poor health outcomes. Economic disadvantage was defined as having either a Medicaid enrollment rate above the median value for all the zip codes in Maryland, or a Supplemental Nutrition Program for Women, Infants, and Children (WIC) participation rate above the median value for all the Maryland zip codes.[30] Health outcomes were

similarly based on comparison to median zip codes in Maryland, with eligibility depending on a potential HEZ having life expectancy below the median value for the state, or a percentage of low birth weight infants above the median value of the state.[30]

Once deemed eligible, the HEZ were selected based on their ability to impact communities through their goals, strategy, coalition, collaboration, and program management. An important aspect in the selection of the HEZ was that each HEZ coalition should include, "a diverse array of health and community partners, with specific roles and deep historical experience working in the HEZ."[22,23] Each HEZ identified a lead agency; either a hospital, local health department, medical center or health system; to distribute funds and provide program oversight. Broadly, coalition members within the HEZ include: a local housing authority, a school based wellness center, mental health providers, behavioral health and substance abuse service providers, federally qualified health centers (FQHCs), a health education center, a weight loss program, a fire department/Emergency Medical Services and others.

In 2012, 19 HEZ applications were received and reviewed by an independent review committee of experts and in January 2013, five HEZ were selected.[23] Each HEZ outlined their intervention activities and the specific health conditions they planned to target. A description of each HEZ, the lead agency, and the intervention activities is listed in Table 1.

HEZ Conditions

Although it is widely acknowledged that social determinants of health have a significant impact on health outcomes, there is little documented evidence on how health systems should target social determinants to improve population health.[31] To evaluate the potential impact of programs such as HEZ, this study will assess the impact of HEZ activities on inpatient and ED utilization for HEZ conditions. All five HEZs targeted cardiovascular disease and diabetes. In

addition, the Annapolis and St. Mary's HEZs targeted Asthma/COPD, the Caroline/Dorchester HEZ worked on pediatric asthma, and the two HEZ that focused on M/SUDs were St. Mary's and Caroline/Dorchester. The health conditions targeted by each HEZ are displayed in Table 2.2. A list of the conditions that fall within each "HEZ Condition" category is listed in Table 2.3.

Methods

Study Sample

The study sample includes patients who had an inpatient discharge or ED visit for one of the seven evaluated conditions between 2009 and 2016 and were residents of either the HEZ or HEZ eligible zip codes. The treatment group includes patients from the 16 residential zip codes that received the HEZ intervention; the comparison group, the "HEZ eligible" communities, includes patients from the 94 zip codes that were eligible to apply to the HEZ intervention but did not receive HEZ funding.

Data

This longitudinal study is based on a secondary analysis of administrative emergency department and inpatient hospital discharge data from the state of Maryland from 2009 to 2016. The data were provided by the Maryland Health Services Cost Review Commission (HSCRC) and include primary diagnosis codes ICD-9 and ICD-10, age, source of admission, and patient zip codes. Discharges for the conditions of interest were aggregated at the zip code and year level. Discharges for residents from 16 HEZ or 94 HEZ eligible zip codes were included in the study. To account for differences between the HEZ and HEZ eligible communities, the HSCRC inpatient and ED discharge data was merged with 2010 US Census and 2010-2014 Census American Community Survey (ACS) data at the zip code level. In addition to demographic and socioeconomic characteristics about residents in each zip code, the census data also provided

information about the number of residents per zip code, which was used to calculate discharges per capita and to appropriately weight the data by zip code population.

Covariates

The intervention was implemented at the zip code level and demographic and socioeconomic characteristics from the ACS data were used as covariates in the model to control for differences between the HEZ and HEZ eligible groups. The covariates included in this study are: age, sex, race/ethnicity, poverty level, employment status, median household income, educational attainment, marital status, and housing status.[32]

Outcome measures

The outcome measures are inpatient and ED discharges for a HEZ condition. Table 3 provides information about the conditions and composite measures.

HEZ Conditions

The seven HEZ condition outcomes include pediatric asthma, psychoses, and composite measures for cardiovascular disease, diabetes, COPD/Asthma, substance use disorders and depression. The cardiovascular, diabetes and asthma condition categories are measured using the Prevention Quality Indicators (PQIs; versions 6 and 7) developed by the Agency for Health Quality Research (AHRQ).[33] The PQIs are a set of measures that can be used with hospital inpatient discharge data to measure access to and quality of care for ambulatory care sensitive conditions (ACSC).[34] The conditions included in this study are both conditions that the HEZ stated they would focus on, and conditions for which good outpatient quality of care can prevent inpatient hospitalizations or a visit to the ED. While the AHRQ PQI measures were developed to measure inpatient care utilization, they have been used to evaluate ED utilization as well.[34-37] The pediatric asthma indicator is based on the AHRQ Pediatric Quality Indicator (PDI), which is

similar to PQIs and can be used with hospital data to gather information about the quality of pediatric healthcare.[38] The three categories included in M/SUDs (substance use disorders; depression, anxiety or stress reactions; and psychoses or bipolar disorders) were conceptualized and reviewed in 2013 by a workgroup of health experts who were tasked with evaluating and providing feedback on PQIs adapted for the ED setting and were drawn from an Healthcare Cost and Utilization Project (HCUP) statistical brief.[39]

Marker Conditions

For the sensitivity analysis, changes in HEZ conditions are compared to changes in urgent but not ambulatory care sensitive "marker conditions."[40-43] Discharges and visits for marker conditions should not be affected by the HEZ Initiative activities and are used in the analysis as a proxy for unobserved time-varying zip code level changes in access to care.[44] The marker conditions, chosen by a medical advisory panel of internists and pediatricians, are considered conditions for which the provision of timely and effective ambulatory care should have little effect on the need for a hospital admission or ED visit.[42,45] Based on the work of previous studies, the marker conditions included in this analysis are: appendicitis with appendectomy, gastrointestinal obstruction, and fracture of the hip or femur.[40]

Analysis

The difference-in-differences approach will be used to identify the association between HEZ implementation and changes in inpatient and ED discharges for the conditions of interest. This difference-in differences linear regression examines the association of belonging to a HEZ group after the intervention and the likelihood of being discharged for a HEZ condition or marker condition.[46] The analysis was conducted on an intention-to-treat basis, residents of the 16

HEZ zip codes were considered exposed to the HEZ intervention regardless of their participation in HEZ activities.

The difference-in-differences approach ensures that unobserved variables that remain constant over time will not bias the estimated effect of the intervention because it includes a comparison group, residents of HEZ eligible zip codes, that is exposed to the same trends but is not exposed to the intervention.[47,48] In the difference-in-difference analysis, two differences in outcomes are observed: 1) the difference after vs. before the HEZ intervention in the group exposed to the program, and 2) the difference after vs. before the intervention in the control group. The change in outcomes associated with the HEZ intervention beyond background trends are estimated by subtracting the first difference by the second difference. Theoretically, if there is no relationship between the HEZ intervention and the outcomes, then the difference-in-differences estimate is equal to 0.[48] The analysis is conducted with the common shocks assumption - that any event occurring before or after the intervention will affect both the treatment and control group equally.[48,49]

Estimates of differential changes were obtained using zip code and year level linear regression models adjusted for random effects and zip code level demographic and socioeconomic characteristics. The random effects model was chosen after Hausman tests consistently failed to reject the null hypothesis that the random effects model was more efficient. Resident zip codes in the HSCRC administrative data were used to determine allocation to the HEZ (treatment) or HEZ eligible (comparison) group. For each HEZ and HEZ eligible zip code, we computed the number of inpatient stays and ED visits, per 1,000 residents, for each outcome and also used weighting to take into consideration differences in zip code population size. The pre-HEZ intervention period is 2009 to 2012 and the HEZ intervention, or post, period is 2013 to

2016. The analysis includes an indicator variable to denote that a discharge was in a HEZ zip code, and this was interacted with an indicator for the HEZ intervention period. The model also includes a year variable to account for changes over time.

All five HEZ conducted activities to target cardiovascular disease and diabetes; therefore discharges for zip codes from all five HEZ were included in the treatment group for the analysis of those two conditions. For the remaining five conditions, only discharges from the zip codes of the HEZs that targeted those health issues were included as the treatment group in the analysis. For example, given that Caroline/Dorchester was the only HEZ to target pediatric asthma, only discharges for residents from Caroline/Dorchester were included as the "treatment group" in the analysis of that outcome. Discharges from the 94 HEZ eligible zip codes were used in the comparison group in the analysis of all seven conditions.

For the sensitivity analysis, the same difference-in-differences analysis was conducted to examine changes in inpatient and ED utilization for marker conditions, comparing all five HEZ to the HEZ eligible zip codes.

Results

The study examined conditions from a total of 344,744 inpatient stays and 1,241,190 ED visits in the HEZ zip codes and 2,324,687 inpatient stays and 6,774,361 ED visits from the HEZ eligible groups over the eight-year study period. Table 2.4 displays a comparison of the demographic and socioeconomic characteristics of the residents in the HEZ and HEZ eligible zip codes. Compared to residents in the HEZ eligible zip codes, on average, residents in the HEZ zip codes had a higher proportion of Black residents, were more likely to be below the federal poverty level, were less likely to be married and were less likely to be part of the labor force.

Comparing Pre and Post HEZ Intervention Trends

Figures 2.2 and 2.3 show the trends in per capita inpatient and ED utilization, weighted by zip code population, for HEZ and HEZ eligible zip codes from 2009 to 2016. The inpatient trends in Figure 2.2 show that for most conditions, the HEZ zip codes had a higher rate of per capita inpatient use compared to the HEZ eligible zip codes. For cardiovascular disease and diabetes, there is a larger decrease in the post-intervention trend for the HEZ group compared to the HEZ eligible group. For the remaining conditions, perhaps given that fewer zip codes were included in the HEZ group, there is more variability in the HEZ trends compared to the HEZ eligible trends. Similar results are found in the charts for ED visits by condition.

Changes in Utilization for the HEZ communities

Tables 2.5 and 2.6 show the per capita rate of discharges for each condition in the pre and post periods for the HEZ and HEZ eligible groups, as well as the estimated differential change. Table 2.5 shows the adjusted differential changes in the pre-intervention (2009-2012) and post-intervention (2013-2016) period comparing inpatient discharges for HEZ and HEZ eligible residents. Based on the analysis, the HEZ intervention was associated with a decrease of 0.79 cardiovascular discharges per 1,000 (95% CI, -11.9 to -0.40; P <0.001) and a decrease of 0.39 diabetes discharges per 1,000 (95% CI, -0.65 to -0.13; P =0.004). However, the HEZ intervention was also associated with an increase in per capita inpatient discharges for asthma pediatric asthma, substance use disorders and depression. Compared to the HEZ eligible group: the Annapolis and St. Mary's HEZs had a post-intervention increase of 1.43 asthma discharges per 1,000 (95% CI, 0.79 to 2.08; P < 0.001); the Caroline/Dorchester HEZ had a post intervention increase of 0.12 pediatric asthma discharges per 1,000 (95% CI, 0.01 to 0.23; P = 0.036); the Caroline/Dorchester and St. Mary's HEZs had a post intervention increase of 0.59 substance abuse discharges per 1,000 (95% CI, 0.34 to 0.85; P <0.001); and the

Caroline/Dorchester and St. Mary's HEZs had a post intervention increase of 0.31 depression and suicidal ideation discharges per 1,000 (95% CI, 0.01 to 0.61; P= 0.04)

Table 2.6 shows the adjusted differential changes in the pre-intervention and post-intervention ED visits for HEZ and HEZ eligible residents. Compared to the HEZ eligible group, the Caroline/Dorchester HEZ had a post intervention increase of 0.44 pediatric asthma ED visits per 1,000 (95% CI, 0.00 to 0.89; P = 0.048).

Sensitivity Analysis

As expected, there was no statistically significant differential change in the composite marker conditions measure for either inpatient stays or ED visits.

Discussion

This study examined changes in inpatient stays and ED visits for certain conditions associated with the HEZ intervention. Using a difference-in-differences analysis, the study compared changes in utilization among residents in HEZ zip codes with changes in utilization for residents in HEZ eligible zip codes. The conditions that are measured are the ones that were targeted by one or more of the HEZs. This includes cardiovascular disease, diabetes, asthma, pediatric asthma, and mental and substance use disorders (M/SUDs). Hospitalization and ED visits for these conditions are potentially avoidable if there is good quality ambulatory care and care coordination.[39] The results show that the HEZ is associated with a decrease in inpatient stays for cardiovascular disease and diabetes, but an increase in inpatient stays for asthma, pediatric asthma and certain M/SUD outcomes. In addition, the intervention was associated with an increase in ED visits for pediatric asthma.

The decrease in inpatient stays in cardiovascular disease and diabetes in the HEZ communities after HEZ was implemented may be due to the broad range of activities that the

intervention conducted to address these two conditions. All five HEZs targeted these two chronic conditions – each with an approach that was tailor made for their community – and included the provision of both social service and health service resources. A few examples of the community services provided include: a weight reduction program through Maryland Healthy Weighs, the Prime Time Sister Circles healthy lifestyle intervention, health literacy campaigns, health education programs through the Neighborhood Wellness Advocates, free fitness classes, walking groups and nutrition and cooking classes. Examples of health service activities which may have impacted these conditions include: establishing primary care and navigational services, increased care coordination – particularly for high utilizers of care, recruitment of primary care providers, recruitment and training of community health workers, health screenings for cardiovascular disease and diabetes, and opening primary care offices, specialty care practices and Patient Centered Medical Homes. In addition, each HEZ implemented activities to address gaps in their communities. For example, the St. Mary's HEZ implemented a transportation program to shuttle patients to the health care and social services resources that they needed but did not have easy access to.

There are several possible explanations for why there was a significant differential post-intervention increase in asthma, pediatric asthma, substance use disorders and depression for the HEZ groups. It is not likely that an increase in services in the HEZ communities contributed to worse health outcome, and furthermore communities may have targeted those conditions because of worsening outcomes. It is possible that the impact of increased health care and community services takes longer to impact those conditions or that program activities targeting those conditions began later in the intervention period. In addition, increased health screening or

education regarding those conditions could make it more likely that patients with an M/SUD condition seek necessary intensive care in an inpatient setting.

Study Strengths and Limitations

A strength of the study is that it is longitudinal and includes four years of data pre and post HEZ implementation and also includes a HEZ eligible comparison group. Another strength is that this evaluation examines the impact of a multidisciplinary community based program on individuals regardless of insurance type – existing studies often evaluate programs that are limited to Medicare or Medicaid beneficiaries.[28,29] In addition, this analysis includes a sensitivity analysis to test for external factors that could impact overall inpatient and ED hospital use.

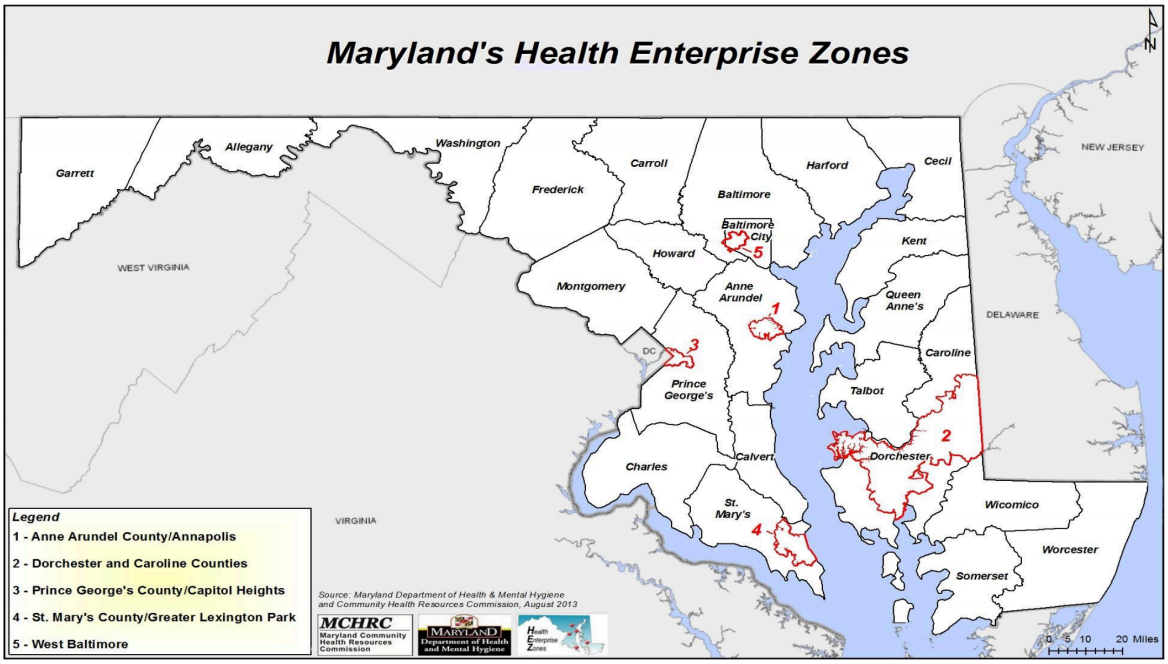
This study has several limitations. The first is the spillover effect– a difference-in-differences analysis cannot account for the fact that the intervention may have an impact on zip codes that are not part of the HEZ but are geographically located near the HEZ. Perhaps those patients benefited from HEZ activities even though they are not technically residents of a HEZ.[48] A second limitation is the lag effect - although HEZ began in 2013, it may have taken time for HEZ activities to be implemented, they may have been implemented at different times across HEZ, or HEZ may not have impacted hospital utilization until a few years later. In addition, as in most observational studies, there may be unobserved confounders. Also, the system of coding diagnoses, the International Statistical Classification of Diseases and Related Health Problems, was updated from ICD 9 to ICD 10 in the last quarter of 2015. The change in coding may have impacted the consistency in capturing diagnoses. Another limitation is the lack of data on non-ED outpatient visits or ambulatory care service use in Maryland. Lastly, the findings of this study may not be generalizable because Maryland has unique hospital payment system – the All-

Payer model and global budgets create financial incentives for hospitals in Maryland that other states do not have.[1,50,51]

Conclusion

This study found that the HEZ intervention activities were associated with a decrease in inpatient utilization for individuals with cardiovascular disease and diabetes. However, an increase in inpatient utilization for asthma, pediatric asthma and certain M/SUD conditions, as well as ED pediatric asthma visits, were also associated with the HEZ intervention. This may be an indication that the impact of the intervention may take longer to reduce utilization for those conditions, or that health education and screening increased the decision for residents with those conditions to seek care in an inpatient setting.

Figure 2.1. Map of Maryland Indicating the five HEZ Communities



*Source: Maryland Department of Health &Mental Hygiene and Community Health Resources Commission, August 2013

Table 2.1. Description of HEZ Characteristics and Activities

1.) Annapolis Community Health Partnership (ACHP)	
Lead Agency	Anne Arundel Medical Center
HEZ Characteristics	Suburban Community: Annapolis Jurisdiction: Anne Arundel County Population: 36,805
Zip code	21401
Jobs Added[2]	4.0 FTEs[3] – Licensed independent practitioners[4]: 1.0 FTE – Other licensed or certified practitioners[5]: 1.0 FTE – Support staff: 2.0 FTEs
Primary Activities	• Established a primary care medical home in a residential public housing building (Morris Blum). • Provided primary care and navigational services to residents of Morris Blum and the surrounding community. • Established 1:1 coaching services on medication management and tobacco cessation and health screenings for hypertension, domestic violence, and depression; Provided on site phlebotomy services. Registered nurse case manager and community health workers (CHWs) provided care coordination services via home and clinic visits.
2.) Caroline/Dorchester Counties' Competent Care Connections (CCC)	
Lead Agency	Dorchester County Health Department
HEZ Characteristics	Rural Community: Mid-Shore Region Jurisdiction: Dorchester and Caroline Counties Population: 36,123
Zip codes	21613, 21631, 21632, 21643, 21659, 21664, 21835
Jobs Added	29.23 FTEs – Licensed independent practitioners: 4.3 FTEs – Community Health Workers: 3.25 FTEs – Support staff: 15.23 FTEs – Other 6.45 FTEs
Primary Activities	• Recruited six physicians and a practice to the HEZ – all focused on primary care or mental health services. • Established the Dorchester School Based Wellness center that expanded access to pediatric care and implemented an asthma management program. Due to the support of the HEZs, the school based wellness center had an additional 28-hours/per week of Nurse Practitioner coverage. The center also provided primary mental health care and counseling services were provided in two other schools. • Provided support and training for a CHW program. • Established Care Coordinator program to provide follow up, home visits and telehealth services through a partnership between Choptank Community Health and Associated Black Charities CHW Team. • Provided access to mental health and substance abuse peer recovery and support services through the Chesapeake Voyagers, Inc., DRI-DOCK, and expansion of the Eastern Shore Mobile Crisis Response Team. • Provided access to an intensive lifestyle management program through Maryland Healthy Weighs to reduce adult obesity and address conditions such as diabetes and hypertension.
3.) Prince George's County HEZ (PGCHEZ)	
Lead Agency	Prince George's County Health Department
HEZ Characteristics	Suburban

	Community: Capitol Heights Jurisdiction: Prince George's County Population: 38,626
Zip code	20743
Jobs Added	21.86 FTEs – Licensed independent practitioners: 4.4 FTEs – Other licensed or certified practitioners: 4.83 FTEs – Community Health Workers: 5 FTEs – Support staff: 7.63 FTEs
Primary Activities	• Established four Patient Centered Medical Homes and one specialty care practice. • Increased the number of health care providers in the HEZ including 4.4 FTE licensed independent practitioners and 4.8 other licensed or certified health care practitioners. • Created a Community Care Coordination Team that has built partnerships with two local hospitals, primary care and behavioral health providers, eight County agencies, state and federal partners, Fire/EMS, pharmacists, case managers, payers and home health providers. • Through the Community Care Coordination Program, created 21 standardized, evidence-based Care Pathways to link clients to medical, clinical and social services. • Established a Public Health Information Network that connected to the Maryland health information exchange and allows for lab, radiology and clinical records to be delivered to HEZ care providers. • Implemented a comprehensive Health Literacy Campaign utilizing Health Literacy Ambassadors and developed a Health Literacy Mobile App to help promote health literacy. • Implemented Prime Time Sister Circles healthy lifestyle intervention.
4.) St. Mary's County/ Greater Lexington Park (GLP HEZ)	
Lead Agency	MedStar St. Mary's Hospital
HEZ Characteristics	Rural Community: Greater Lexington Park Jurisdiction: St. Mary's County Population: 34,035
Zip codes	20634, 20653, 20667
Jobs Added	21.2 FTEs – Licensed independent practitioners: 7.5 FTEs – Other licensed or certified practitioners: 3.7 FTEs – Community Health Workers: 3.5 FTEs – Support staff: 6.5 FTEs
Primary Activities	• Opened the MedStar St. Mary's Hospital primary care office, East Run Medical Center community clinic, and a dental van • Supported the expansion of psychiatry services, Walden Sierra, Inc. mental health services, and primary care services through *Get Connected to Health* mobile clinic • Integrated primary care and behavioral health services • Neighborhood Wellness Advocates (NWA) and RN care coordinators provided care coordination, health screening and education programs within the community • Implemented a transportation program to improve access to health care, social services and other health-related services. Also created a specialty transportation program to take patients to specialty care outside the HEZ • Improved access to prescription medication through an "E Prescribe" system and buprenorphine-certified psychiatric services.
5.) West Baltimore (WBPCAC)	
Lead Agency	Bon Secours Baltimore Health System
Characteristics	Urban

	Community: West Baltimore Jurisdiction: Baltimore City Population: 137,823
Zip codes	21216, 21217, 21223, 21229
Jobs Added	22.8 FTEs – Licensed independent practitioners: 3 FTEs – Other licensed or certified practitioners: 16 FTEs – Community Health Workers: 1 FTE – Support Staff: 2.8 FTEs
Primary Activities	• Increased, integrated and coordinated the primary care workforce. • Implemented a tiered (30 day and 60 day) RN case manager and Community Health Worker care coordination program targeting patients at-risk of hospital or ED utilization. • Provided 105 health or social service career scholarships and Career Readiness trainings. • Delivered free fitness classes to thousands of residents through partnerships with neighborhood recreation centers. • Supported health programs targeting cardiovascular disease with activities like blood pressure screenings, fitness classes, walking groups, nutrition and cooking classes.

[1] "Jobs added" numbers drawn from the HEZ quarterly reports. Jobs added include new or retained jobs within a HEZ. These practitioners are hired or retained to provide services within the HEZ as a result of the HEZ initiative and may or may not receive HEZ funding

[2] FTE = Full time employee

[3] Licensed independent practitioners = physician, dentist, nurse practitioner, physician assistant, nurse midwife

[4] Other licensed or certified health care practitioners = registered nurse, social worker, certified medical assistant, licensed practical nurse, dental hygienist, certified addictions counselor

Table 2.2. Health Conditions Targeted by each HEZ

	Annapolis/Morris Blum	Caroline/ Dorchester	Prince George's County	St. Mary's	West Baltimore
Cardiovascular	X	X	X	X	X
Diabetes	X	X	X	X	X
Asthma/COPD	X			X	
Pediatric Asthma		X			
Substance Use Disorders		X		X	
Depression, anxiety and stress		X		X	
Psychoses and bipolar		X		X	

Table 2.3. Composition of HEZ and Marker Condition Measures

HEZ Indicator Conditions	Marker Indicator Conditions
Ambulatory care sensitive	Urgent, insensitive to primary care

• Cardiovascular
  • Hypertension (PQI 07)
  • Heart Failure (PQI 08)
• Diabetes
  • Diabetes short term (PQI 01)
  • Diabetes long term (PQI 03)
  • Uncontrolled diabetes (PQI 14)
  • Lower extremity amputation among patients with diabetes (PQI 16)
• Asthma
  • COPD/Asthma in older adults (PQI 05)
  • Asthma in younger adults (PQI 15)
• Pediatric asthma (PDI 14)
• Substance use disorders
  • Alcohol-related
  • Substance use-related
• Depression, anxiety, stress reactions
  • Depression, anxiety, or stress reactions
  • Suicidal ideation/attempt
• Psychoses or bipolar disorder
	Marker Condition Composite Measure
	• Appendicitis with appendectomy
	• Fracture of hip/femur
	• Gastrointestinal obstruction

Defined by diagnoses codes at the ICD-9 and ICD-10 level using AHRQ Preventable Quality Indicators (PQI), Pediatric Quality Indicator (PDIs). For M.SUDs, the diagnoses codes were taken from codes the Agency for Healthcare Research and Quality, Healthcare Cost and Utilization Project, Statistical Brief #216.	Defined by diagnoses codes at the ICD-9 and ICD-10 level

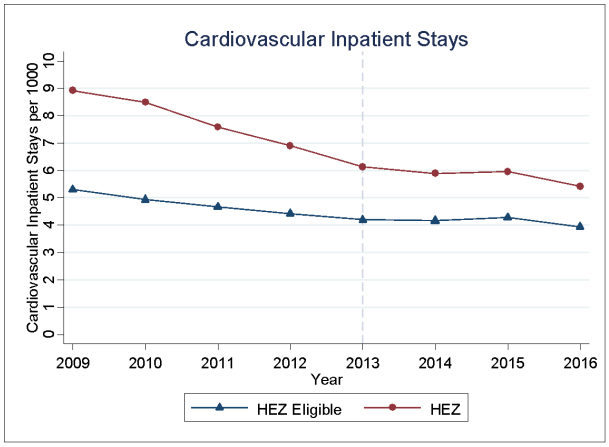
Table 2.4. Comparison of HEZ and HEZ Eligible groups by demographic and socioeconomic characteristics

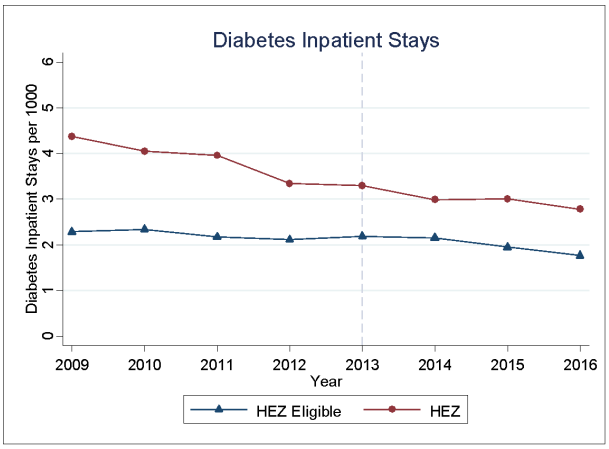
	HEZ Awarded Zip Codes (N=16)	**HEZ Eligible Zip Codes (N=94)**	**P-value**
Total Population, mean [95% confidence interval]	31,836.4 [25,936.1, 37,736.7]	35,700.5 [31,851.2, 39,549.9]	0.279
Median Household Income (2014)	$49,989.02 [$36323.73, $63654.0]	$60,564.28 [$56999.33, $64129.23]	0.141
Population characteristics mean % [95% confidence interval]			
Women	52.6 [51.6, 53.6]	52.0 [51.3, 52.6]	0.268
Men*	47.4 [46.4, 48.4]	48.0 [47.4, 48.7]	0.268
Race/Ethnicity			
White*	29.2 [12.1, 46.4]	42.5 [36.4, 48.7]	0.150
Black	62.1 [43.0, 81.3]	39.7 [33.6, 45.8]	0.029
Asian	1.6 [0.8, 2.4]	4.3 [3.3, 5.3]	<0.001
Native/Other	2.4 (1.6, 3.1]	2.9 [2.6, 3.1]	0.230
Hispanic	4.6 [2.3, 6.9]	10.6 [7.8, 13.4]	0.002
Age Distribution (years)			
Age 0-17	23.3[21.2, 25.5]	22.8 [22.2, 23.5]	0.649
Age 18-24	10.1 [9.1, 11.1]	10.1 [9.4, 10.8]	0.996
Age 25-44	26.1 [24.8, 27.4]	29.0 [27.9, 30.1]	0.012
Age 45-64*	26.8 [25.9, 27.7]	25.8 [25.3, 26.4]	0.072
Age 65-79	9.8 [8.4, 11.1]	8.8 [8.3, 9.4]	0.205
Age 80 over	3.6 [2.6, 4.6]	3.3 [2.9, 3.7]	0.513
Under 50% Federal Poverty Level (FPL)	8.2 [5.1, 11.3]	4.6 [3.9, 5.3]	0.025
50 to 74% FPL	5.1 [3.0, 7.1]	2.7 [2.3, 3.0]	0.026
75 to 99% FPL	4.0 [2.5, 5.4]	3.1 [2.7, 3.5]	0.252
100 to 124% FPL*	4.4 [3.0, 5.7]	3.5 [3.1, 3.9]	0.207
125 to 149% FPL	5.1 [3.9, 6.4]	3.8 [3.5, 4.2]	0.051
150 to 174% FPL	5.3 [3.9, 6.8]	4.1 [3.8, 4.4]	0.097
175 to 184% FPL	1.7 [1.2, 2.3]	1.7 [1.5, 1.8]	0.774
185 to 199% FPL	2.7 [2.2, 3.2]	2.5 [2.3, 2.8]	0.536
Over 200% FPL	63.5 [53.4, 73.5]	74.1 [71.9, 76.3]	0.043
Unemployed	8.6 [6.4, 10.8]	6.6 [6.2, 7.0]	0.072
Employed	54.0 [49.2, 58.8]	61.6 [59.8, 63.5]	0.004
Not in Labor Force*	36.9 [32.8, 40.9]	31.4 [29.7,33.1]	0.016
Educational Attainment			
No High School	4.9 [3.6, 6.2]	6.0 [4.7, 7.3]	0.224
Some High School	13.0 [9.7, 16.4]	8.8 [7.9, 9.6]	0.017
High School*	32.5 [28.3, 36.7]	30.0 [28.0, 32.0]	0.304
Some College	22.2 [20.1, 24.4]	20.8 [19.9, 21.8]	0.237

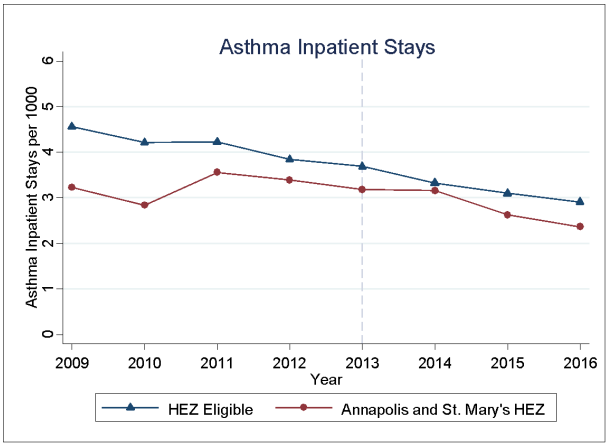
Associates Degree	5.4 [4.8, 6.0]	6.3 [5.9, 6.7]	0.017
College Degree	12.9 [8.6, 17.2]	16.3 [14.7, 17.9]	0.147
Advanced Degree	9.0 [4.7, 13.4]	11.8 [10.2, 13.4]	0.240
Marital Status			
Married	32.2 [24.6, 39.8]	40.5 [38.4, 42.5]	0.040
Never Married*	45.3 [38.5, 52.0]	39.5 [37.6, 41.4]	0.104
Widowed	7.1 [6.4, 7.9]	6.1 [5.6, 6.5]	0.019
Separated	4.0 [3.2, 4.7]	3.2 [3.0, 3.4]	0.049
Divorced	11.4 [10.7, 12.2]	10.8 [10.4, 11.2]	0.149
Home Occupancy Rates			
Occupied Homes*	81.3 [74.0, 88.6]	90.0 [88.8, 91.4]	0.021
Vacant Homes	18.7 [11.6, 26.0]	9.9 [8.6, 11.2]	0.021
Owner Occupied Homes*	52.8 [44.9, 60.6]	58.6[56.1, 61.0]	0.166
Renter Occupied Homes	47.2 [39.4, 55.1]	41.4 [39.1, 43.9]	0.166

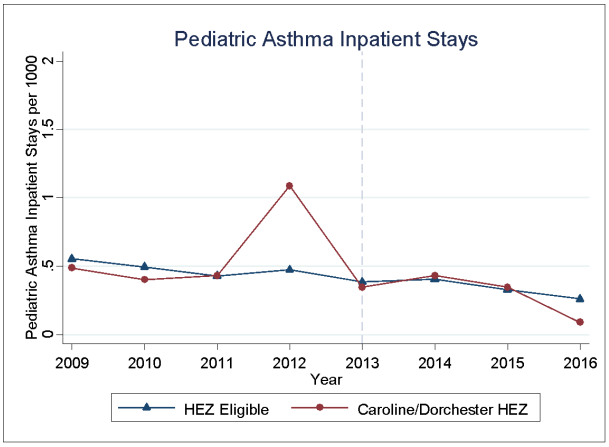
*Indicates reference covariate
- Source: 2010 US Census and from the 2010-2014 U.S. Census American Community Survey (ACS).
- Data is weighted by the total population in Maryland

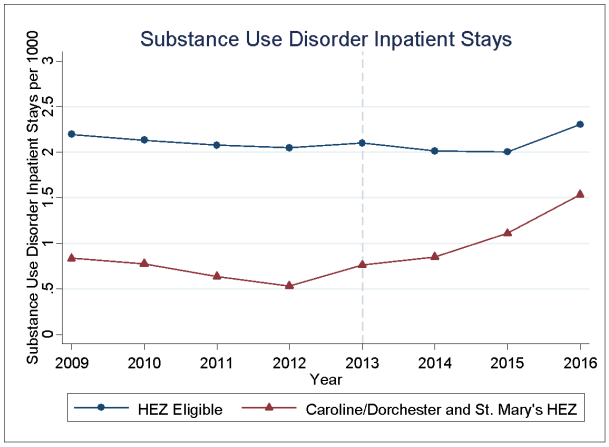
Figure 2.2. Trends in Inpatient Stays for HEZ Conditions for residents of HEZ and HEZ Eligible Zip Codes, 2009-2016

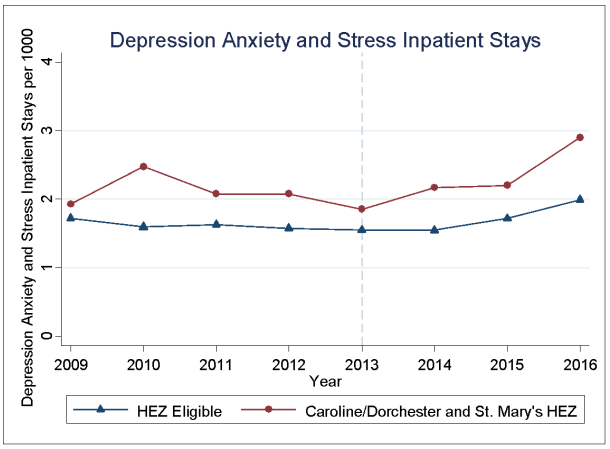


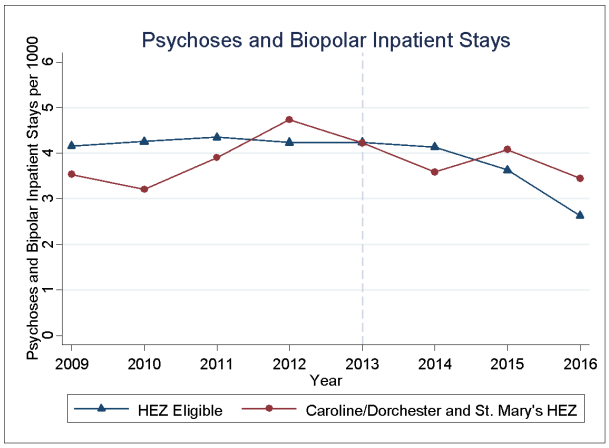






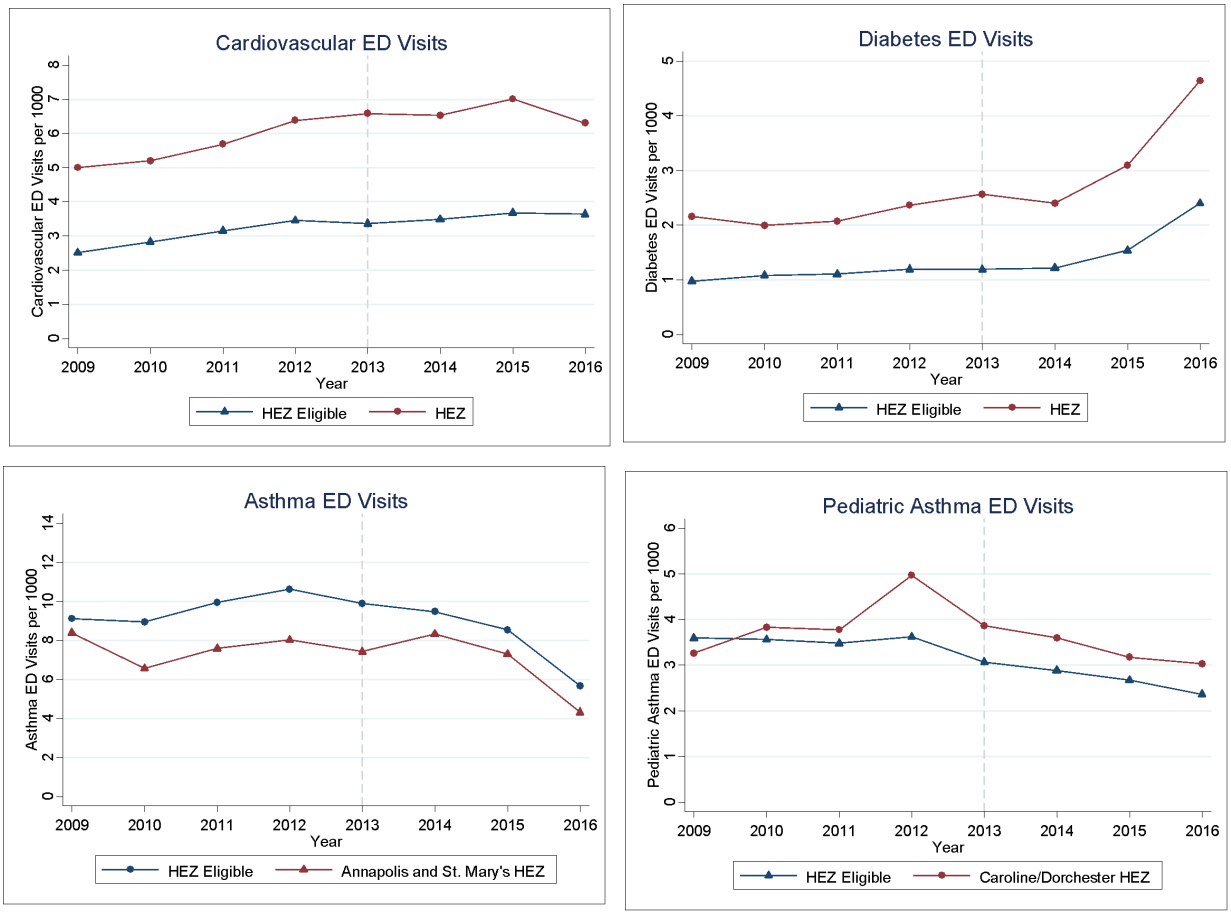


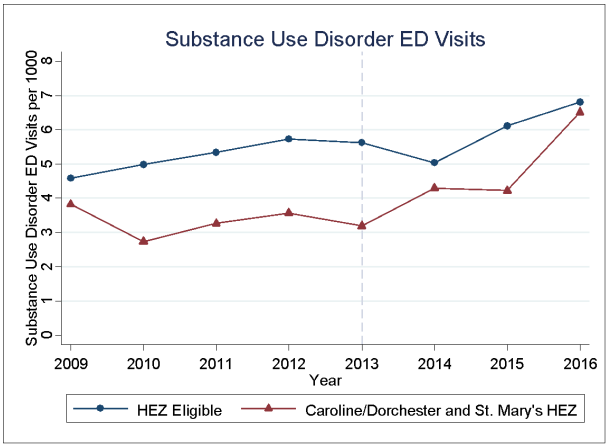


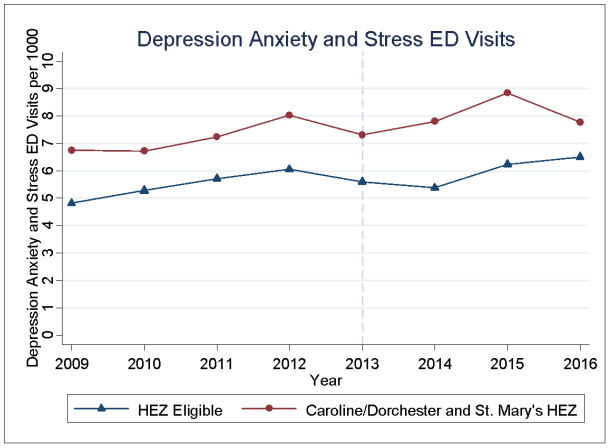


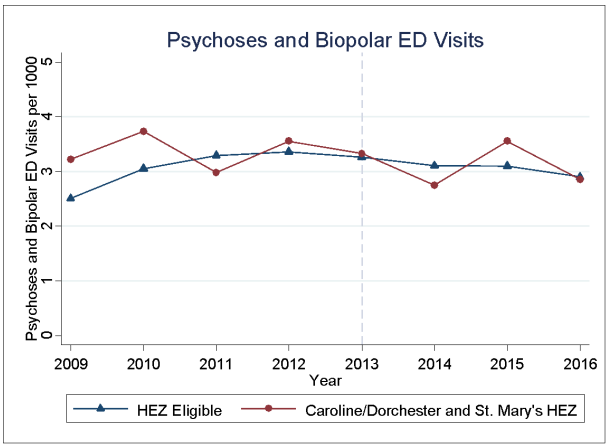
These plots show the annual per capita rates of inpatient hospital utilization among residents of the HEZ and HEZ eligible zip codes from 2009 to 2016. Rates are weighted by the total population in Maryland. The charts indicate if the conditions were targeted by all five HEZs or by a subset of HEZs. If conditions were targeted by a subset of HEZs, then only utilization for residents of those communities were included in the HEZ group. The HEZ intervention was implemented in 2013, therefore the vertical lines dividing each panel at distinguish between the pre-HEZ intervention period (left) and the HEZ intervention period (right).

Figure 2.3. Trends in Emergency Department (ED) Visits for HEZ Conditions for Residents of HEZ and HEZ Eligible Zip Codes, 2009-2016









These plots show the annual per capita rates of Emergency Department visits among residents of the HEZ and HEZ eligible zip codes from 2009 to 2016. Rates are weighted by the total population in Maryland. The charts indicate if the conditions were targeted by all five HEZs or by a subset of HEZs. If conditions were targeted by a subset of HEZs, then only utilization for residents of those communities were included in the HEZ group. The HEZ intervention was implemented in 2013, therefore the vertical lines dividing each panel at distinguish between the pre-HEZ intervention period (left) and the HEZ intervention period (right).

Table 2.5. Estimated effect of HEZ intervention on inpatient stays for conditions of interest

Outcome	HEZ				HEZ Eligible				Difference-in-Differences		
	Pre HEZ (2009-2012)		HEZ Implementation (2013-2016)		Pre HEZ (2009-2012)		HEZ Implementation (2013-2016)				
Inpatient		95% CI		95% CI		95% CI		95% CI	DD	95% CI	p-value
Cardiovascular	6.41	(5.77, 7.04)	5.84	(5.20, 6.47)	4.11	(3.83, 4.40)	4.34	(4.05, 4.63)	-0.79	(-1.19, -0.40)	<0.001***
Diabetes	2.94	(2.61, 3.26)	2.83	(2.50, 3.15)	1.85	(1.70, 2.00)	2.13	(1.97, 2.28)	-0.39	(-0.65, -0.13)	0.004**
Asthma[1]	3.10	(2.22, 3.98)	4.61	(3.82, 5.49)	3.62	(3.41, 3.84)	3.69	(3.48, 3.91)	1.43	(0.79, 2.08)	<0.001***
Pediatric Asthma[2]	0.23	(0.02, 0.44)	0.36	(0.15, 0.57)	0.36	(0.29, 0.42)	0.37	(0.31, 0.43)	0.12	(0.01, 0.23)	0.036*
Substance Abuse[3]	0.63	(-0.11, 1.37)	1.11	(0.37, 1.85)	1.91	(1.66, 2.15)	1.79	(1.54, 2.04)	0.59	(0.34, 0.85)	<0.001***
Depression[3]	2.07	(1.61, 2.42)	2.10	(1.69, 2.50)	1.71	(1.56, 1.86)	1.48	(1.32, 1.63)	0.31	(0.01, 0.61)	0.040*
Psychoses[3]	3.40	(2.48, 4.33)	3.44	(2.51, 4.37)	3.55	(3.22, 3.84)	3.71	(3.39, 4.04)	-0.13	(-0.61, 0.36)	0.607
Marker Conditions	2.76	(2.45, 3.07)	2.67	(2.35, 2.98)	1.91	(1.76, 2.05)	1.92	(1.77, 2.06)	0.11	(-0.33, 0.12)	0.350

[1]HEZ includes: Annapolis and St. Mary's
[2]HEZ includes: Caroline/Dorchester
[3]HEZ includes: Caroline/Dorchester and St. Mary's
* p-value<0.05; ** p-value<0.01; *** p-value<0.001

Table 2.6. Estimated effect of HEZ intervention on emergency department visits for conditions of interest

Outcome	HEZ				HEZ Eligible				Difference-in-Differences		
	Pre HEZ (2009-2012)		HEZ Implementation (2013-2016)		Pre HEZ (2009-2012)		HEZ Implementation (2013-2016)				
Emergency Department		95% CI		95% CI		95% CI		95% CI	DD	95% CI	p-value
Cardiovascular	5.51	(5.04,5.99)	5.17	(4.70, 5.65)	3.40	(3.17, 3.62)	2.93	(2.70, 3.15)	0.13	(-0.27, 0.53)	0.527
Diabetes	2.80	(2.52, 3.09)	2.41	(2.13, 2.70)	1.56	(1.42, 1.71)	1.03	(0.89, 1.18)	0.14	(-0.16, 0.44)	0.356
Asthma[1]	9.26	(6.95, 11.57)	10.01	(7.70, 13.32)	8.56	(8.01, 9.11)	8.73	(8.18, 9.28)	0.58	(-1.03, 2.19)	0.482
Pediatric Asthma[2]	2.74	(1.65, 3.84)	2.78	(1.69, 3.87)	3.02	(2.70, 3.33)	2.61	(2.30, 2.92)	0.44	(0.00, 0.89)	0.048*
Substance Abuse[3]	3.94	(2.19, 5.68)	3.26	(1.52, 5.01)	5.68	(5.07, 6.29)	4.71	(4.10, 5.32)	0.30	(-0.58, 1.17)	0.509
Depression[3]	7.89	(6.83, 8.94)	6.50	(5.45, 7.55)	5.96	(5.57, 6.35)	5.07	(4.68, 5.46)	-0.49	(-1.23, 0.24)	0.189
Psychoses[3]	3.30	(2.35, 4.25)	2.72	(1.76, 3.67)	2.88	(2.55, 3.21)	2.65	(2.32, 2.98)	-0.35	(-0.80, 0.10)	0.128
Marker Conditions	1.07	(0.90, 1.24)	0.75	(0.58,0.92)	0.56	(0.47, 0.64)	0.33	(0.25, 0.41)	-0.10	(-0.26, 0.07)	0.246

[1]HEZ includes: Annapolis and St. Mary's
[2]HEZ includes: Caroline/Dorchester
[3]HEZ includes: Caroline/Dorchester and St. Mary's
* p-value<0.05; ** p-value<0.01; *** p-value<0.

CHAPTER THREE: MANUSCRIPT TWO

The Impact of the Community-Based HEZ Intervention on Hospital Utilization for Medicaid Enrollees

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Abstract

Background: The HEZ Initiative is a community-based intervention implemented in underserved five communities in Maryland from 2013 – 2016. The HEZ provides resources and support to communities to: reduce health disparities among racial and ethnic minority populations and among geographic areas; improve health care access and health outcomes in communities; and reduce health care costs and hospital admissions and readmissions.

Objective: To examine the association between the HEZ Initiative and inpatient stays and Emergency Department visits for the Medicaid population in Maryland.

Methods: This study has a quasi-experimental pre-post design and the difference-in-differences analysis includes eight years of Maryland hospital utilization data and Medicaid enrollment data from 2009 to 2016. The study compares outcomes for Medicaid enrollees who utilized care and reside in either one of the 16 zip codes that are part of the five HEZ communities or one of the 94 zip codes that were eligible for HEZ but were not part of the initiative. The inpatient and ED outcomes measured were total discharges; Prevention Quality Indicator (PQI) discharges; and discharges for a composite measure of HEZ targeted conditions.

Results: The analysis found, compared to Medicaid enrollees in the HEZ eligible group, Medicaid enrollees in the HEZ group have 0.94 (95% CI, 0.93 to 0.96; P<0.001) times the risk of an inpatient stay, 0.81 (95% CI, 0.79 to 0.83; P<0.001) times the risk of a PQI inpatient stay, and 0.94 (95% CI, 0.91 to 0.96; P<0.001) times the risk of HEZ condition inpatient stay. For ED utilization, compared to Medicaid enrollees in the HEZ eligible group, Medicaid enrollees in HEZ communities have 1.09 (95% CI, 1.07 to 1.10; P<0.001) times the risk of a ED visit, 1.13 (95% CI, 0.10 to 1.16; P<0.001) times the risk of a PQI ED visit and 1.14 times (95% CI, 1.05 to 1.18; P<0.001) times the risk of the risk of a HEZ condition ED visit.

Conclusion: The findings of this study show that the HEZ Initiative activities were associated with a change in hospital utilization for the Medicaid population in HEZ communities. The intervention was associated with decrease in inpatient stays for all outcomes and was associated with an increase in total ED visits for all outcomes. The decrease in inpatient stays may be due to increased access to care provided by the HEZ intervention.

Introduction

This paper will examine the impact of the Maryland Health Enterprise Zone (HEZ) Initiative on hospital utilization for the Medicaid population in Maryland. The HEZ is a community-based intervention that was implemented in underserved communities in Maryland from 2013 to 2016. The goal of the HEZ was to target underserved communities and provide them with resources to: reduce geographic and racial/ethnic health disparities, improve access to care and improve health outcomes, and reduce: health care costs, hospital admissions and readmissions.[23] Five HEZ communities in Maryland were selected – each with one lead agency and multiple partner organizations. The HEZ Initiative brought together various agencies in one community to work on addressing their common goals. Examples of HEZ intervention activities include: establishing primary and specialty care practices; providing chronic disease screening; health education and medication management; recruiting health care providers; improving care coordination and care transition; implementing a school based wellness center; and providing transportation services in rural communities.

With a budget of $4 million per year, the HEZ program was administered through a joint effort by the Maryland Community Health Resource Commission (CHRC) and the Maryland Department of Mental Hygiene (DHMH).[22] After a competitive application process, the following communities were selected: Annapolis/Morris Blum (Annapolis), Caroline and Dorchester Counties, Capital Heights in Prince George's County (Prince George's), Greater Lexington Park in St. Mary's Country (St. Mary's), and West Baltimore in Baltimore City (West Baltimore). Figure 3.1 shows the map of Maryland indicating the location and size of the HEZ communities These five communities varied on a wide set of characteristics including population size, rural, suburban and urban designation, as well as the specific needs of their population.

Each HEZ program was tailored to address the health and social service needs of the community. For example in the rural Caroline/Dorchester HEZ, transportation was a key barrier to health care and therefore the HEZ program funded and managed a shuttle to transport HEZ residents to doctor appointments and the pharmacy. In the urban West Baltimore HEZ where rates of cardiovascular disease are high, intervention activities were focused on improving access to healthy foods, creating safe physical activity opportunities, and providing health education and health screening services for residents with chronic conditions. HEZ community characteristics and intervention activities, by HEZ, are listed in Table 3.1.

To be eligible to apply to the HEZ Initiative, communities in Maryland needed to qualify based geography, and the economic and health status of their residents. To apply, a potential HEZ community had to meet the requirements listed below[30]:

- Geography: consist of a contiguous geographic area
- Economic – a HEZ must have:
    - A Medicaid enrollment rate above the median value for all zip codes in Maryland, or
    - A Supplemental Nutrition Program for Women, Infants, and Children (WIC) participation rate above the median value for all the Maryland zip codes.
- Health – a HEZ must have:
    - A life expectancy below the median value for the state, or
    - A percentage of low birth weight infants above the median value of the state.

Unlike many similar community based interventions, the HEZ intervention was not limited to a specific population based on payor – the HEZ resources and program activities were

available to all residents of a zip code regardless of insurance type or insurance status or ability to pay. However, given recent Medicaid policy changes and the fact that the HEZ in part targeted communities with higher rates of Medicaid enrollees, this study will specifically examine the association between HEZ Initiative implementation and changes in hospital utilization for the Medicaid population.

Medicaid expansion and Medicaid Policy in Maryland

Medicaid is a health insurance program for eligible low-income adults, children, pregnant women, elderly adults and people with disabilities.[52] The program is jointly funded and administered by federal and state governments. Both nationally and in Maryland, the Medicaid program has undergone a number of changes due to the passage of the 2010 Patient Protection and Affordable Care Act (ACA). Prior to the ACA, Medicaid covered low-income children, pregnant women, the elderly, individuals with disabilities and some parents, but excluded other low-income adults. The ACA expanded Medicaid eligibility to adults younger than 65 with incomes at or below 138% of the federal poverty level.[52,53] Due to a 2012 Supreme Court decision, the expansion of Medicaid eligibility became optional for states– Maryland is one of the 33 states, including DC, that have chosen to expand Medicaid.[54] Medicaid eligibility expansion became effective on January 1, 2014 and Medicaid expansion was 100% federally funded for the first three years – 2014 to 2016.[53] After this initial period, federal funding declines to 95% in 2017, 94% in 2018, 93% in 2019 and 90% in 2020 and beyond.[53] As a result of Medicaid eligibility expansion, as well as an improved Medicaid enrollment process and increased outreach and enrollment efforts, the number of Medicaid beneficiaries has increased nationally and within Maryland.

In 2017, the Maryland Department of Legislative Services released a report, "Assessing the Impact of Health Care Reform in Maryland," that in part examined Medicaid trends in Maryland since the passage of the ACA.[53] This report found that as of January 2017, Maryland observed a significant increase in health care coverage due to the expansion of Medicaid – 291,000 individuals in Maryland were newly enrolled in Medicaid. Due to Medicaid expansion, the Maryland Health Benefit Exchange - another feature of the ACA - and other reforms, Maryland's uninsured rate decreased from 10.1% in 2012, to 6.7% in 2015 – a decrease of 33.6%. The percentage of Maryland residents who were enrolled in Medicaid grew from 16.4% in fiscal year (FY) 2012 to 20.8% in FY 2015 – a 27% increase.[53]

In order to understand the impact of such policy and program changes, it is essential to understand Maryland's unique hospital payment system. Maryland is the only state with an All-Payer Model which stipulated that all health care payers will pay the same rates to hospitals for both inpatient and outpatient hospital services.[1,2] The goal of the All-Payer Model is to improve the quality of care and reduce spending for Maryland residents.[2] In addition, in 2014 Maryland also implemented a global budget payment program. The Global Budget Payment program was implemented in January 2014 and limits overall hospital spending by establishing global hospital budgets.[51] Therefore, the state has placed each hospital on an all-payer global budget which covers both inpatient and outpatient hospital charges. The hospital payment program in Maryland financially incentivizes moving care to lower-costs setting where appropriate and incentives an investment in prevention.[55]

Community-Based Programs targeting Medicaid enrollees

Multiple community-based programs have worked to improve health outcomes and reduce potentially avoidable utilization for the Medicaid population. Indicating the importance of

such multidisciplinary community based programs, in May 2017, the Centers for Medicare and Medicaid Services (CMS) launched a 5-year, $157 million program – Accountable Health Communities (AHC) – to assess if identifying and addressing the health related social needs of a community can appropriately reduce health care utilization among Medicare and Medicaid beneficiaries.[26]

Studies have shown that local community health teams that provide integrated services may reduce high-cost utilization and improve quality of care for Medicaid enrollees.[28,29] One such study examined community health teams (CHTs) in eight states that received state payments to provide services to Medicaid enrollees. These CHTs are similar to the HEZs in that they: are comprised of multidisciplinary teams, target high utilizers, engage in care coordination and patient education, provide transportation resources where necessary, and connect patients to community resources.[29] The evaluation of CHTs found that these health teams can help increase the capacity of small and medium sized primary care practices that may struggle to meet the intense social, chronic illness and behavioral health needs of their Medicaid patients. In addition, an early analysis of two of the states found that the teams improve quality of care and slow cost growth. [29]

Another community-based intervention targeting Medicaid enrollees is Hennepin Health program in Minnesota. Hennepin Health was created in 2011 and was based in a safety net Accountable Care Organization to redesign the health care workforce to improve coordination of physical, behavioral, social and economic aspects of care specifically for the expanded community of Medicaid beneficiaries.[28] The Hennepin Health model is similar to HEZ in that the goal of the program was to increase use of preventive care and reduce potentially avoidable hospital admissions and ED visits in its high-risk population.[28] In addition, the program

emphasizes that in order to improve population health, it is necessary to have staffing models that are responsive to local needs and involve social services and other organizations that have an impact on health.[28,56] The results of an evaluation of this study found that the program shifted care from hospitals to an outpatient setting, realized cost savings, and increased the percentage of patients receiving diabetes, cardiovascular and asthma care at optimal levels.[28] In addition, the Hennepin Health program reduced emergency department visits by 9% through coordination with housing and community service specialists in an integrated health services and social services system.[14,28]

The objective of this study is to examine the association between HEZ Initiative activities and changes in hospital utilization for Medicaid enrollees residing in HEZ communities. A significant proportion of state budgets are allocated to Medicaid program and state budget deficits are driven in part by rising Medicaid costs.[29] Therefore, programs that can improve health outcomes and reduce potentially avoidable care utilization, lowering costs, are of great interest.[29,57,58]

Methods

Study Sample

The study sample includes HEZ or HEZ eligible residents who had an ED or inpatient discharge from 2009 to 2016 and whose primary insurance payer was Medicaid. The treatment group includes Medicaid enrollees from the 16 HEZ awarded zip codes, and the comparison group consists of residents from 94 zip codes who were eligible to apply to the HEZ program but did not receive the intervention.

Data

Inpatient and ED discharges for 2009 to 2016 were analyzed using administrative data provided by the Maryland Health Services Cost Review Commission (HSCRC). These data include primary diagnosis ICD-9 and ICD-10 codes, age, source of admission, and patient zip codes, and primary insurance payor. Discharges were aggregated by zip code and year, and only discharges for residents of the 16 HEZ or 94 HEZ eligible zip codes were included in the analysis. The Hilltop Institute provided data on Medicaid enrollment and Medicaid enrollee demographic information. These data included total number of Medicaid enrollees by zip code and year, as well as information about enrollee age, race/ethnicity, sex and dual-eligible Medicaid/Medicare status. In order to control for zip code characteristics, the HSCRC and Medicaid enrollment data was merged with 2010 US Census and 2010-2014 Census American Community Survey (ACS) data at the zip code level.[32]

Covariates

The HEZ program was implemented at the zip code level, therefore, zip code level resident and community characteristics were included as covariates in the model to control for differences between the HEZ and HEZ eligible groups. The covariates that were taken from the Medicaid enrollment data include: age, sex, and race/ethnicity. Using the Census data, the additional demographic and community characteristics include: educational attainment, housing status, and employment status.

Outcome measures

Three outcome measures were included for both the inpatient and ED data analysis: total discharges, the Prevention Quality Indicators (PQIs; versions 6 and 7) composite measure developed by the Agency for Health Quality Research (AHRQ),[33] and a "HEZ Condition" composite measure. Total discharges include all inpatient and ED discharges excluding cancer

and trauma. The AHRQ PQI indicator is composed of conditions that are sensitive to ambulatory care and can be used to measure access and quality of care for both inpatient hospitalizations and ED visits.[34] The HEZ condition indicator is a composite measure of conditions that the HEZ stated they would target with HEZ intervention activities and include the conditions: pediatric asthma, psychoses, and composite measures for cardiovascular disease, diabetes, COPD/Asthma, substance use disorders and depression. The specific composition and sources for the two composite measures are listed in Table 3.2.

Marker Conditions

As a sensitivity analysis, changes in PQI and HEZ condition composite measures will be compared to changes in a "marker condition" measure. Marker conditions are urgent conditions that are not sensitive to changes in ambulatory care and therefore should not be impacted by the HEZ intervention activities. Changes in utilization for these conditions in one group compared to the other may indicate policies or activities other than the HEZ that are influencing care utilization in a disproportionate way.[44] The marker conditions are appendicitis with appendectomy, gastrointestinal obstruction, and fracture of the hip or femur[40] and were chosen by a medical advisory panel of internists and pediatricians.[42,45]

Statistical Analysis

The analysis will include a multivariate difference-in-difference study design using a negative binomial count model with results reported as a ratio of incidence rate ratios. The models were estimated using random effects and control for Medicaid enrollee demographic characteristics and zip code characteristics. The difference-in-differences model includes a dummy variable to indicate if a zip code was part of the HEZ group or the HEZ Eligible group and this was interacted with a dummy variable for pre-intervention (2009-2012) or post-

intervention (2013-2016) year. The model also includes a year variable to account for changes over time.

The coefficients on the HEZ-year interaction term were used to estimate the impact of the HEZ intervention activities on inpatient and ED: discharges, PQI discharges, HEZ condition discharges and discharges for marker conditions. The marker conditions serve as a proxy for unobserved time-varying changes in access to care. The random effects model was chosen due to the fact that Hausman tests consistently failed to reject the null hypothesis that the random effects model was more efficient. Due to overdispersion, the negative binomial model was more appropriate than the Poisson regression model.

Results

The study includes 129,997 Medicaid inpatient discharges and 631,951 Medicaid ED visits in the HEZ zip codes and 670,567 Medicaid inpatient discharges and 2,715,497 Medicaid ED visits from the HEZ eligible groups over the eight-year study period. Discharges and ED visits for individuals who are dually eligible for Medicare and Medicaid coverage are excluded from the analysis.

Table 3.3 compares residents of the HEZ and HEZ eligible zip codes by demographic and socioeconomic characteristics. The information for this table was drawn from both the Medicaid enrollment data and from the Census ACS data. To account for sparsely populated zip codes, the data are weighted by Medicaid enrollment or Maryland population where appropriate. Comparing the two groups, the HEZ zip codes have a larger proportion of Medicaid enrollees, have more residents in the 18-64 year age group and have a greater proportion of Black non-Hispanic residents. In addition, compared to the HEZ Eligible zip codes, HEZ residents have fewer college graduates, fewer employed residents and live in areas with more vacant homes.

Trends in Medicaid Enrollment, Inpatient Stays and ED Visits Over Time

Figures 3.2, 3.3 and 3.4 display the trends in Medicaid enrollment, and inpatient stays and ED visits for Medicaid enrollees residing the HEZ and HEZ Eligible zip codes from 2009 to 2016. Figure 3.2 shows that the Medicaid enrollment rate for both groups increased at a similar rate over time, with a noticeable increase in enrollment in 2014 – the year of Medicaid eligibility expansion in Maryland. In addition, compared to residents of HEZ eligible zip codes, a greater proportion of HEZ residents are insured by Medicaid. Figure 3.3 shows the trends for the two groups for total inpatient discharges, PQI inpatient stays and HEZ Condition inpatient stays over time. The light grey vertical line indicates the year the HEZ initiative began. The charts show that discharges for all three categories decreased over time. Figure 3.4 displays the trends for total ED visits, ED PQI visits and ED HEZ condition visits. In contrast to the inpatient stays, ED visits for all three categories increased over time for both groups.

Changes in Utilization for HEZ residents

Tables 3.4 and 3.5 show the differential changes in the pre-HEZ and post-HEZ period comparing outcomes for HEZ and HEZ Eligible residents. The results of the analysis are reported as a ratio of incidence rate ratios. Table 3.4 shows that compared to Medicaid enrollees in the HEZ eligible group, Medicaid enrollees in the HEZ group have 0.94 (95% CI, 0.93 to 0.96; P<0.001) times the risk of an inpatient stay, 0.81 (95% CI, 0.79 to 0.83; P<0.001) times the risk of a PQI inpatient stay, and 0.94 (95% CI, 0.91 to 0.96; P<0.001) times the risk of HEZ condition inpatient stay. Table 3.5 displays the results of the analysis on ED visits - compared to Medicaid enrollees in the HEZ eligible group, Medicaid enrollees in HEZ communities have 1.09 (95% CI, 1.07 to 1.10; P<0.001) times the risk of a ED visit, 1.13 (95% CI, 0.10 to 1.16; P<0.001) times the risk of a PQI ED visit and 1.14 times (95% CI, 1.05 to 1.18; P<0.001) times

the risk of the risk of a HEZ condition ED visit. As expected, when comparing the two groups, there was no statistically significant change for the marker condition category for either inpatient stays or ED visits.

Discussion

The objective of this study was to examine the association between the HEZ Initiative and hospital utilization for Medicaid enrollees in the five HEZ communities. The results show that the HEZ program is associated with a decrease in total inpatient stays for all outcomes and an increase in ED visits for all outcomes.

As the inpatient trend charts show, inpatient utilization is decreasing for both HEZ and HEZ eligible residents perhaps in part because of the global budget payment model that was implemented in 2014. However, the significant decrease in inpatient stays for HEZ Medicaid enrollees compared to HEZ Eligible Medicaid enrollees may be due to the HEZ activities that targeted individuals with chronic conditions. These activities include chronic disease screening, health education, and increased availability of primary care and specialty care services. Although there was a decrease in inpatient hospital utilization comparing the HEZ residents to the HEZ eligible residents, there was also an associated increase in ED use. Given in the increase in access to care due to the HEZ Initiative, the decrease in inpatient utilization may be the result of emergency departments directing patients to health care resources in the community instead of admitting them to the hospital. Given that hospitals were often part of the HEZ community coalitions, it is likely that hospital staff were aware of the new community resources. In addition, the hospital payment system in Maryland encourages hospitals to move patients to lower-cost settings where appropriate.

Study Strengths and Limitations

This study has several strengths; one strength is that the study includes hospital utilization and Medicaid enrollment data for 2009 to 2016 – making it possible to conduct a longitudinal analysis. In addition, this study includes a sensitivity analysis using marker conditions to test for unobserved activities or policies that may have an impact on overall hospital use. The analysis also controls for Medicaid expansion and other area level factors and includes a comparison group.

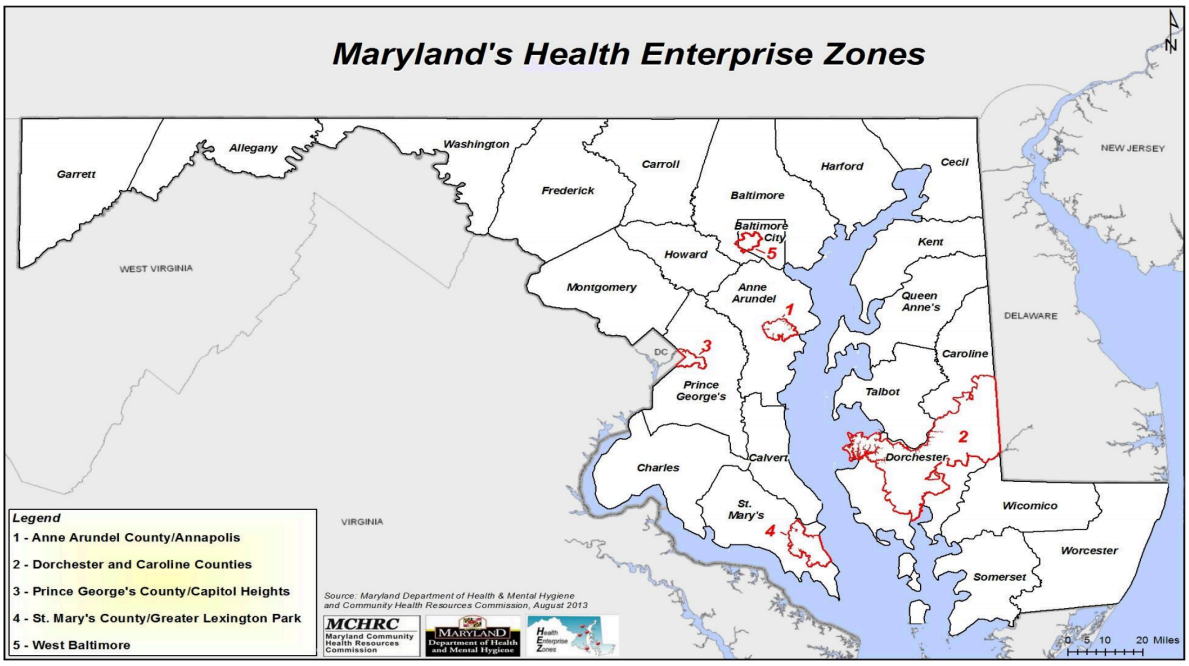
This analysis also includes several limitations. Although the analysis excludes dually eligible Medicaid enrollees, the demographic characteristics in the Medicaid enrollment data represent both dually eligible and non-dual eligible Medicaid enrollees. In addition, the hospital system of coding diagnoses, the International Statistical Classification of Diseases and Related Health Problems (ICD), was updated from the ICD-9 version to the ICD-10 version during the last quarter of 2015 and this may have had an effect on the consistency of capturing diagnoses. Another limitation is the fact that the data do not include information on non-ED outpatient visits, which would have provided information on the use of ambulatory care service use in Maryland. Lastly, given that Maryland has a unique hospital payment system – the All-Payer model and global budgets – the findings of this study may not be generalizable to other states.[1,50,51]

Conclusion

The goal of the HEZ Initiative is to provide resources to underserved communities in Maryland in order to improve health outcomes and reduce health disparities. The five communities awarded with HEZ funding tailored their HEZ program to address specific health and social service needs of their population and to attract skilled health care providers to their communities. The five HEZ communities have a greater proportion of Medicaid enrollees than

the rest of the state and the HEZ program provides a model for providing care to this population. Although there may be a lag effect in realizing the full impact of the HEZ, the program is associated with reduced inpatient utilization, which are often costly. Given the significant financial cost of Medicaid on state budgets, it may be prudent to invest in community-based activities that can improve health outcomes for Medicaid enrollees.

Figure 3.1. Map of Maryland Indicating the five HEZ Communities



*Source: Maryland Department of Health &Mental Hygiene and Community Health Resources Commission, August 2013

Table 3.1: Description of HEZ Characteristics and Activities

1.) Annapolis Community Health Partnership (ACHP)	
Lead Agency	Anne Arundel Medical Center
HEZ Characteristics	Suburban Community: Annapolis Jurisdiction: Anne Arundel County Population: 36,805
Zip code	21401
Jobs Added[2]	4.0 FTEs[3] – Licensed independent practitioners[4]: 1.0 FTE – Other licensed or certified practitioners[5]: 1.0 FTE – Support staff: 2.0 FTEs
Primary Activities	• Established a primary care medical home in a residential public housing building (Morris Blum). • Provided primary care and navigational services to residents of Morris Blum and the surrounding community. • Established 1:1 coaching services on medication management and tobacco cessation and health screenings for hypertension, domestic violence, and depression; Provided on site phlebotomy services. Registered nurse case manager and community health workers (CHWs) provided care coordination services via home and clinic visits.
2.) Caroline/Dorchester Counties' Competent Care Connections (CCC)	
Lead Agency	Dorchester County Health Department
HEZ Characteristics	Rural Community: Mid-Shore Region Jurisdiction: Dorchester and Caroline Counties Population: 36,123
Zip codes	21613, 21631, 21632, 21643, 21659, 21664, 21835
Jobs Added	29.23 FTEs – Licensed independent practitioners: 4.3 FTEs – Community Health Workers: 3.25 FTEs – Support staff: 15.23 FTEs – Other 6.45 FTEs
Primary Activities	• Recruited six physicians and a practice to the HEZ – all focused on primary care or mental health services. • Established the Dorchester School Based Wellness center that expanded access to pediatric care and implemented an asthma management program. Due to the support of the HEZs, the school based wellness center had an additional 28-hours/per week of Nurse Practitioner coverage. The center also provided primary mental health care and counseling services were provided in two other schools. • Provided support and training for a CHW program. • Established Care Coordinator program to provide follow up, home visits and telehealth services through a partnership between Choptank Community Health and Associated Black Charities CHW Team. • Provided access to mental health and substance abuse peer recovery and support services through the Chesapeake Voyagers, Inc., DRI-DOCK, and expansion of the Eastern Shore Mobile Crisis Response Team. • Provided access to an intensive lifestyle management program through Maryland Healthy Weighs to reduce adult obesity and address conditions such as diabetes and hypertension.
3.) Prince George's County HEZ (PGCHEZ)	
Lead Agency	Prince George's County Health Department

HEZ Characteristics	Suburban Community: Capitol Heights Jurisdiction: Prince George's County Population: 38,626
Zip code	20743
Jobs Added	21.86 FTEs – Licensed independent practitioners: 4.4 FTEs – Other licensed or certified practitioners: 4.83 FTEs – Community Health Workers: 5 FTEs – Support staff: 7.63 FTEs
Primary Activities	• Established four Patient Centered Medical Homes and one specialty care practice. • Increased the number of health care providers in the HEZ including 4.4 FTE licensed independent practitioners and 4.8 other licensed or certified health care practitioners. • Created a Community Care Coordination Team that has built partnerships with two local hospitals, primary care and behavioral health providers, eight County agencies, state and federal partners, Fire/EMS, pharmacists, case managers, payers and home health providers. • Through the Community Care Coordination Program, created 21 standardized, evidence-based Care Pathways to link clients to medical, clinical and social services. • Established a Public Health Information Network that connected to the Maryland health information exchange and allows for lab, radiology and clinical records to be delivered to HEZ care providers. • Implemented a comprehensive Health Literacy Campaign utilizing Health Literacy Ambassadors and developed a Health Literacy Mobile App to help promote health literacy. • Implemented Prime Time Sister Circles healthy lifestyle intervention.
4.) St. Mary's County/ Greater Lexington Park (GLP HEZ)	
Lead Agency	MedStar St. Mary's Hospital
HEZ Characteristics	Rural Community: Greater Lexington Park Jurisdiction: St. Mary's County Population: 34,035
Zip codes	20634, 20653, 20667
Jobs Added	21.2 FTEs – Licensed independent practitioners: 7.5 FTEs – Other licensed or certified practitioners: 3.7 FTEs – Community Health Workers: 3.5 FTEs – Support staff: 6.5 FTEs
Primary Activities	• Opened the MedStar St. Mary's Hospital primary care office, East Run Medical Center community clinic, and a dental van • Supported the expansion of psychiatry services, Walden Sierra, Inc. mental health services, and primary care services through *Get Connected to Health* mobile clinic • Integrated primary care and behavioral health services • Neighborhood Wellness Advocates (NWA) and RN care coordinators provided care coordination, health screening and education programs within the community • Implemented a transportation program to improve access to health care, social services and other health-related services. Also created a specialty transportation program to take patients to specialty care outside the HEZ • Improved access to prescription medication through an "E Prescribe" system and buprenorphine-certified psychiatric services.
5.) West Baltimore (WBPCAC)	
Lead Agency	Bon Secours Baltimore Health System

Characteristics	Urban Community: West Baltimore Jurisdiction: Baltimore City Population: 137,823
Zip codes	21216, 21217, 21223, 21229
Jobs Added	22.8 FTEs – Licensed independent practitioners: 3 FTEs – Other licensed or certified practitioners: 16 FTEs – Community Health Workers: 1 FTE – Support Staff: 2.8 FTEs
Primary Activities	• Increased, integrated and coordinated the primary care workforce. • Implemented a tiered (30 day and 60 day) RN case manager and Community Health Worker care coordination program targeting patients at-risk of hospital or ED utilization. • Provided 105 health or social service career scholarships and Career Readiness trainings. • Delivered free fitness classes to thousands of residents through partnerships with neighborhood recreation centers. • Supported health programs targeting cardiovascular disease with activities like blood pressure screenings, fitness classes, walking groups, nutrition and cooking classes.

[1] "Jobs added" numbers drawn from the HEZ quarterly reports. Jobs added include new or retained jobs within a HEZ. These practitioners are hired or retained to provide services within the HEZ as a result of the HEZ initiative and may or may not receive HEZ funding

[2] FTE = Full time employee

[3] Licensed independent practitioners = physician, dentist, nurse practitioner, physician assistant, nurse midwife

[4] Other licensed or certified health care practitioners = registered nurse, social worker, certified medical assistant, licensed practical nurse, dental hygienist, certified addictions counselor

Table 3.2. Composition of outcome variables

AHRQ PQI Composite Measure	HEZ Indicator Conditions	Marker Indicator Conditions
Ambulatory care sensitive	Ambulatory care sensitive	Urgent, insensitive to primary care

• PQI 01 Diabetes Short-term Complications
• PQI 02 Perforated Appendix
• PQI 03 Diabetes Long-term Complications
• PQI 05 Chronic Obstructive Pulmonary Disease (COPD) or Asthma in Older Adults
• PQI 07 Hypertension
• PQI 08 Heart Failure
• PQI 10 Dehydration
• PQI 11 Bacterial Pneumonia
• PQI 12 Urinary Tract Infection
• PQI 14 Uncontrolled Diabetes
• PQI 15 Asthma in Younger
• PQI 16 Lower-Extremity Amputation among Patients with Diabetes
	○ Cardiovascular
	  • Hypertension (PQI 07)
	  • Heart Failure (PQI 08)
	○ Diabetes
	  • Diabetes short term (PQI 01)
	  • Diabetes long term (PQI 03)
	  • Uncontrolled diabetes (PQI 14)
	  • Lower extremity amputation among patients with diabetes (PQI 16)
	○ Asthma
	  • COPD/Asthma in older adults (PQI 05)
	  • Asthma in younger adults (PQI 15)
	○ Pediatric asthma (PDI 14)
	○ Substance use disorders
	  • Alcohol-related
	  • Substance use-related
	○ Depression, anxiety, stress reactions
	  • Depression, anxiety, or stress reactions
	  • Suicidal ideation/attempt
	○ Psychoses or bipolar disorder
		Marker Condition Composite Measure
		• Appendicitis with appendectomy
		• Fracture of hip/femur
		• Gastrointestinal obstruction

Defined by diagnoses codes at the ICD-9 and ICD-10 level using AHRQ Preventable Quality Indicators (PQI).	Defined by diagnoses codes at the ICD-9 and ICD-10 level using AHRQ Preventable Quality Indicators (PQI), Pediatric Quality Indicator (PDIs). For M.SUDs, the diagnoses codes were taken from codes the Agency for Healthcare Research and Quality, Healthcare Cost and Utilization Project, Statistical Brief #216.	Defined by diagnoses codes at the ICD-9 and ICD-10 level

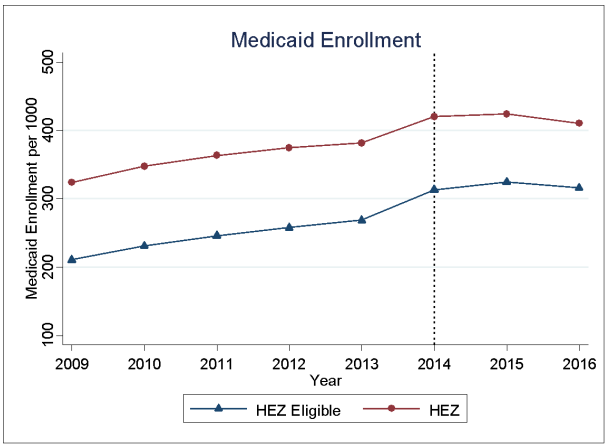
Table 3.3. Comparison of HEZ and HEZ Eligible zip codes by demographic and socioeconomic characteristics

	HEZ Awarded Zip Codes (N=16)	**HEZ Eligible Zip Codes (N=94)**	**P-value**
Medicaid Enrollment Data			
Total Medicaid population [95% CI]	13,682 [10,531.5, 16,833.5]	10,823.3 [9,148.2, 12,498.3]	0.115
Variable *Mean %, [95%CI]*			
Women	56.2 [55.4, 57.0]	56.7 [56.2, 57.1]	0.335
Men*	43.8 [43.0, 44.6]	43.3 [42.9, 43.8]	0.335
Age			
Age 0-17years	41.6 [38.9, 44.4]	46.5 [44.9, 48.2]	0.003
Age 18-64 years*	52.7 [50.1, 55.2]	47.6 [46.1, 49.0]	0.001
Age 65 years and over	5.7 [5.0,6.4]	5.9 [5.4, 6.5]	0.582
Race/Ethnicity			
White, non-Hispanic*	13.7 [6.0, 21.4]	26.5 [20.8, 32.2]	0.009
Black, non-Hispanic	73.9 [64.3, 83.6]	49.1 [42.8, 55.4]	0.000
Hispanic and other	12.4 [9.6, 15.2]	21.4 [20.6, 28.3]	0.000
Census Data			
Total Population, mean [95% CI]	31,836.4 [25,936.1, 37,736.7]	35,700.5 [31,851.2, 39,549.9]	0.279
Variable *Mean %, [95%CI]*			
Educational Attainment			
No High School	4.9 [3.6, 6.2]	6.0 [4.7, 7.3]	0.224
Some High School	13.0 [9.7, 16.4]	8.8 [7.9, 9.6]	0.017
High School*	32.5 [28.3, 36.7]	30.0 [28.0, 32.0]	0.304
Some College	22.2 [20.1, 24.4]	20.8 [19.9, 21.8]	0.237
Associates Degree	5.4 [4.8, 6.0]	6.3 [5.9, 6.7]	0.017
College Degree	12.9 [8.6, 17.2]	16.3 [14.7, 17.9]	0.147
Advanced Degree	9.0 [4.7, 13.4]	11.8 [10.2, 13.4]	0.240
Employment Status			
Unemployed	8.6 [6.4, 10.8]	6.6 [6.2, 7.0]	0.072
Employed	54.0 [49.2, 58.8]	61.6 [59.8, 63.5]	0.004
Not in Labor Force*	36.9 [32.8, 40.9]	31.4 [29.7,33.1]	0.016
Home Occupancy Rates			
Occupied Homes*	81.3 [74.0, 88.6]	90.0 [88.8, 91.4]	0.021
Vacant Homes	18.7 [11.6, 26.0]	9.9 [8.6, 11.2]	0.021
Owner Occupied Homes*	52.8 [44.9, 60.6]	58.6[56.1, 61.0]	0.166
Renter Occupied Homes	47.2 [39.4, 55.1]	41.4 [39.1, 43.9]	0.166

*Indicates reference covariate

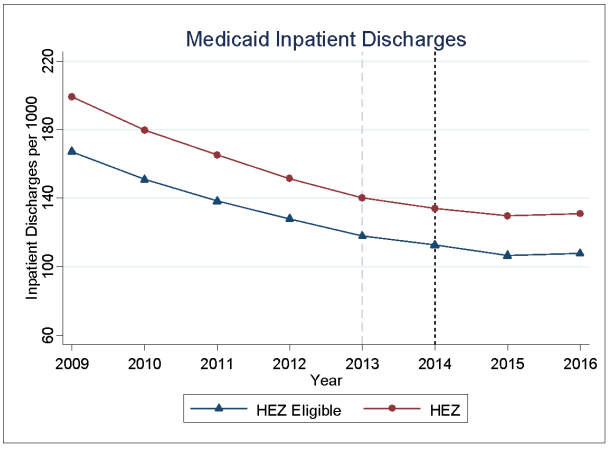
- Source: Medicaid enrollment data form the Hilltop Institute, 2010 US Census and from the 2010-2014 U.S. Census American Community Survey (ACS).
- Data is weighted by the total population in Maryland or population of Medicaid enrollees where appropriate

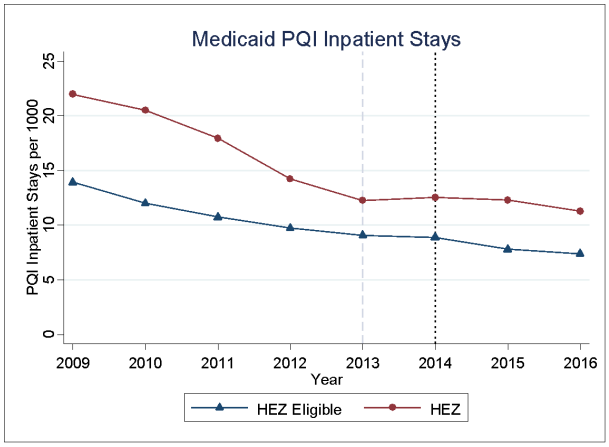
Figure 3.2. Trends in Medicaid Enrollment per 1,000 Residents for HEZ and HEZ Eligible Zip Codes, 2009-2016

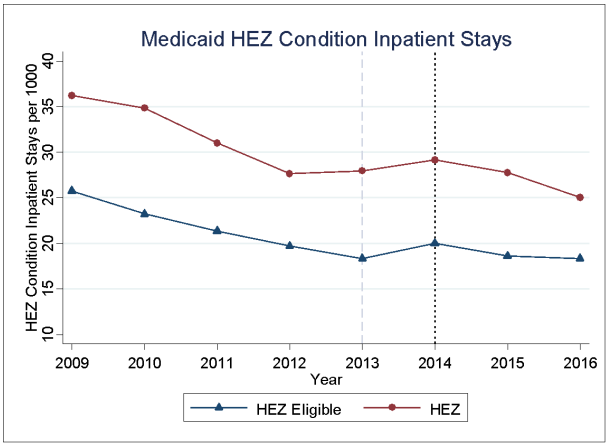


The plot above shows the annual per capita rates of Medicaid enrollment among residents of the HEZ and HEZ eligible zip codes from 2009 to 2016. Rates are weighted by the total population in Maryland. The black vertical line at 2014 indicates when Medicaid expansion began in Maryland.

Figure 3.3. Trends in Inpatient Stays per 1,000 Medicaid Enrollees for HEZ and HEZ Eligible Zip Codes, 2009-2016

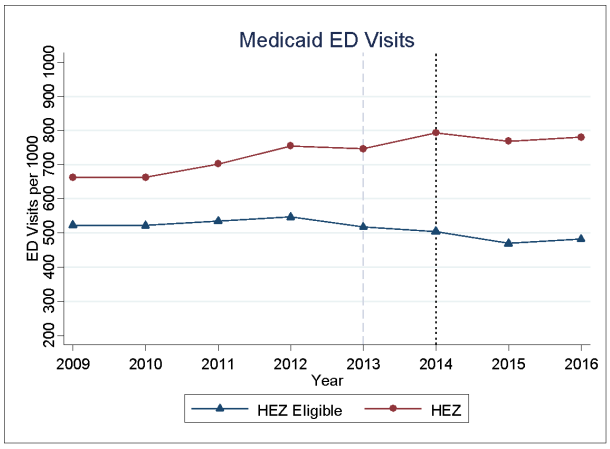


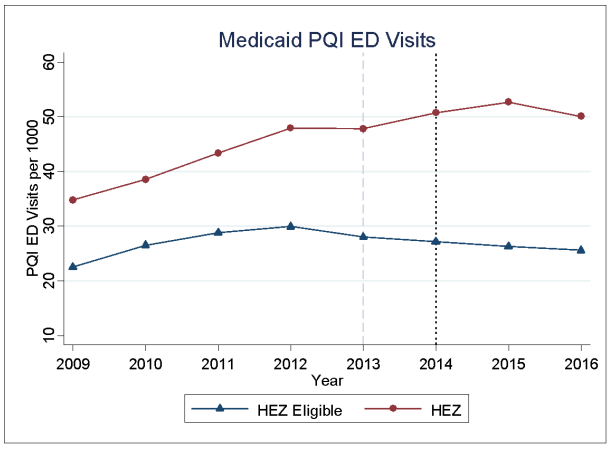


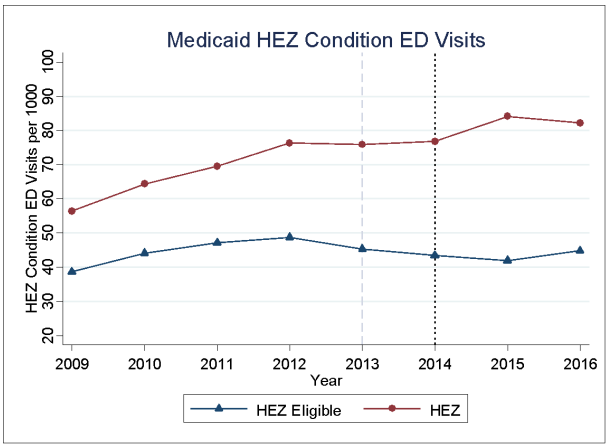


These plots show the annual per capita rates of inpatient hospital utilization among Medicaid enrollees residing in the HEZ and HEZ eligible zip codes from 2009 to 2016. Rates are weighted by the total population of Medicaid enrollees in Maryland. The light grey vertical line at 2013 indicates the beginning of the HEZ intervention and distinguishes between the pre-HEZ intervention period (left) and the HEZ intervention period (right). The black vertical line at 2014 indicates when Medicaid expansion began in Maryland.

Figure 3.4. Trends in ED Visits per 1,000 Medicaid Enrollees for HEZ and HEZ Eligible Zip Codes, 2009-2016







These plots show the annual per capita rates of emergency department utilization among Medicaid enrollees residing in HEZ and HEZ eligible zip codes from 2009 to 2016. Rates are weighted by the total population of Medicaid enrollees in Maryland. The light grey vertical line at 2013 indicates the beginning of the HEZ intervention and distinguishes between the pre-HEZ intervention period (left) and the HEZ intervention period (right). The black vertical line at 2014 indicates when Medicaid expansion began in Maryland.

Table 3.4. Ratio of incidence rate ratios[1] for Medicaid inpatient outcomes, comparing HEZ and HEZ Eligible residents

Outcome	Ratio of Incidence Rate Ratio	95% CI	P-Value
Total Inpatient Stays	0.94	(0.93, 0.96)	<0.001***
PQI Inpatient Stays	0.81	(0.79, 0.83)	<0.001***
HEZ Condition Inpatient Stays	0.94	(0.91, 0,96)	<0.001***
Sensitivity Analysis			
Marker Condition Inpatient Stays	0.95	(0.89, 1.03)	0.209

*p-value<0.05, **p-value<0.01, ***p-value<0.001
[1]Results of difference-in-differences negative binomial model

Table 3.5. Ratio of incidence rate ratios[1] for Medicaid ED visits, comparing HEZ and HEZ Eligible residents

Outcome	Ratio of Incidence Rate Ratio	95% CI	P-Value
Total ED Visits	1.09	(1.07, 1.10)	<0.001***
PQI ED Visits	1.13	(1.10, 1.16)	<0.001***
HEZ Condition ED Visits	1.14	(1.05, 1.18)	<0.001***
Sensitivity Analysis			
Marker Condition ED Visits	1.12	(0.99, 1.27)	0.078

*p-value<0.05, **p-value<0.01, ***p-value<0.001
[1]Results of difference-in-differences negative binomial model

CHAPTER FOUR: MANSUCRIPT THREE

Adoption and Utilization of the CRISP Encounter Notification Service in Maryland and Washington, DC

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Abstract

Background: The Encounter Notification Service, or ENS, is an admission, discharge, transfer (ADT) alert program that was implemented in August 2012.

Objective: This study will review the development of ADT alert programs and describe the use of ENS during the first two years of operation. As of November 2015, all 48 acute care hospitals in Maryland and 6 hospitals in Washington, D.C. could provide ENS notifications to subscribing care entities. The objective of this study is to discuss the policy context and development of ADT alert programs, and describe ENS in detail by examining: (1) the demographics of patients for whom notifications have been sent, (2) the alert preferences of care entities that have subscribed to ENS, and (3) the characteristics of the ENS notifications that have been sent during the study period.

Methods: The data for this study was provided through Audacious Inquiry and includes information about ENS notifications from October 2013 through November 2015. The data includes more than 9 million notifications and information regarding 565 health care entities. This descriptive study looks at trends in notifications over time. The population includes individuals who received care from a hospital in Maryland or Washington D.C. during the study period and for whom an ENS notification was sent. The study also examines the characteristics of health organizations that have subscribed to receive ENS notifications for their patients.

Results: In terms of the distribution of ENS notifications, the majority (40%) were sent to an insurance organization, followed by ambulatory care providers (20%), managed care organizations (10%), hospitals (10%) and FQHCs (9%). Most of the ENS subscribing organizations preferred to receive notifications on a daily basis and for care activities such as inpatient and emergency admission and discharge, as well as emergency registration. About 74%

of notifications were sent for Emergency events with 26% sent for Inpatient hospital events. Among Maryland patients, 57% of notifications were sent for patients in the Baltimore Region, followed by 21% for patients in Suburban Washington, with the remaining notifications for patients from Eastern Shore, Southern and Western Maryland.

Conclusions: This study finds that ENS notifications are received by a wide range of care organizations throughout the state of Maryland and in Washington, D.C. including a large number of health insurers and managed care organizations. In addition to a variety of outpatient care providers, health service organizations such as substance use disorder treatment centers and mental health providers have subscribed to ENS indicating the value of ENS alerts for providers outside of the primary care setting. Looking at notifications over time, it is clear that ENS has been adopted at a growing rate throughout the study period and may serve as a useful care coordination trigger.

Introduction

The Encounter Notification Service, or ENS, is an admission, discharge, transfer (ADT) alert program that was implemented in Maryland in August 2012. ENS functions through the Health Information Exchange, the Chesapeake Regional Information System for our Patients (CRISP), in partnership with the health IT and policy company, Audacious Inquiry. ADT alert programs such as ENS electronically notify ENS participants, such as care providers and health care entities, when a patient under their care is admitted to, transferred, or discharged from a hospital.[17,59] This study discusses the development of ADT alert programs and describes the use of ENS during the first two years of operation, from October 2013 to November 2015. As of November 2015, all 48 acute care hospitals in Maryland and 6 hospitals in Washington, D.C. could provide ENS notifications to subscribing care entities. This study examines (1) the demographics of patients for whom notifications have been sent, (2) the alert preferences of care entities that have subscribed to ENS, and (3) the characteristics of the ENS notifications that have been sent during the study period.

Using Health Information Technology to Improve the Delivery of Care

Health information technology (health IT) has been heralded as an important and effective tool for care coordination in part because of the widespread adoption of electronic health records (EHR) over the past decade.[60,61] In 2009, Congress enacted the stimulus bill called the American Recovery and Reinvestment Act (ARRA).[62] This bill contains a $19 billion program to promote the widespread adoption and use of EHRs and other types of health IT – signifying the critical and prevalent role that electronic information systems will play in the future of health care.[62,63] This program, the Health Information Technology for Economic and Clinical Health (HITECH) Act, was implemented in 2009 to support care providers and hospitals

in their effort to adopt interoperable health IT and to adapt workflow to improve care coordination and quality of care.[64] In addition, the HITECH Act created a leadership structure to guide federal health IT policy, within the Department of Health and Human Services (DHHS), called the Office of the National Coordinator of Health Information Technology (ONC).[62]

Since the implementation of HITECH, EHR adoption has grown significantly. The ONC has reported that as of 2015, 96% of non-federal acute care hospitals have adopted an EHR.[65] In addition, by the end of 2014, 83% of office-based physicians had adopted any EHR.[66] The widespread adoption of EHRs is an essential step in creating a network for health information to be exchanged freely, privately and securely.[60] The extensive implementation and use of EHRs has been coupled with the federal meaningful use program – a program intended to support the effective adoption and use of EHRs. The meaningful use program was developed to promote five specific health care goals: improving quality, safety, and efficiency of care while reducing disparities, engaging patients and families in their care, promoting public and population health, promoting the privacy and security of EHRs, and, importantly, improving care coordination.[60] There are many approaches to improving care coordination and care transitions using health IT. One of these approaches is sending automated admission, discharge, and transfer (ADT) alerts to facilitate follow-up care and clinical transitions. [17]

ADT Alert Programs

CRISP ENS is one of many ADT alert systems implemented in the United States. An ADT alert system is a care coordination system that sends automatic notifications to, typically, a patient's primary care site whenever that patient has been admitted, transferred or discharged in an acute care setting. An ADT alert system provides valuable information for the care transition of a patient – particularly between the acute care setting and ambulatory care setting.[19]

Traditionally, primary care practices have not been informed of their patients' hospitalizations or ED visits in a timely manner, or at all.[16] A literature review of information exchange between acute hospitals and PCPs conducted by Kripalani et al. found that only 17% to 20% of PCP practices were notified that their patients had been discharged from the hospital, and fewer than 20% had received a discharge summary one week post index discharge.[20] Furthermore, of the discharge summaries that were sent, 25% never reached the intended PCP, 38% did not include laboratory results and 21% did not list discharge medications.[20] In the past, discharge summaries were only faxed to a patient's primary care practice if requested, and this typically occurred days or weeks after the patient's index discharge.[16] Health IT such as ENS, which operates in real-time, has the potential to improve timely care coordination and care transitions and to trigger care coordination across health service and community service providers.

The overall goals for ADT alert programs are to: improve timely communication among care providers, improve chronic care management and reduce potentially avoidable hospital utilization.[19] Automated alerts are particularly useful during unexpected transitions of care because an automated alert system will prompt care providers to become aware of important patient events and initiate the necessary exchange of information and follow-up care.[17] A prospective cohort study found that patients without timely PCP follow-up were ten times more likely to be readmitted to the hospital for the same condition within 30 days of hospital discharge.[67]

How ADT Alert Systems Operate

A typical ADT alert system involves three steps[17]:

1.) A patient's admission, discharge or transfer "event" triggers an ADT message to be sent from the admitting or discharging facility, typically an ED or acute care hospital, to an alerting system such as an HIE infrastructure or other intermediary.
2.) The alerting system identifies the corresponding patient and health care provider using information contained within the ADT message such as patient demographic data and runs it through the Master Patient Index (MPI). A MPI is a database that contains unique patient identifiers within and across patient care settings.[68]
3.) The ADT alert system then sends the notification based on guidelines within the system regarding where the alert goes and what person(s) should receive the alert. Information that is often contained in an ADT alert message includes: the patient's personal or demographic information (such as name, insurance, attending physician and next of kin), and when the information has been updated. In addition, the message will indicate if the status of the ADT – such as admitted or discharged – has changed.[19] Some ADT alerts will also contain information about the patient's diagnosis, lab results, and treatment.

ADT messages are typically sent to the patient's PCP. In some cases, additional providers, such as specialists who provide care to the patient on a regular basis, may receive the ADT alert. The outpatient practice receives the ADT alert and, if deemed necessary, the care provider or care team initiates the process of following up with the patient – improving post-discharge transition and providing care management for patients with chronic conditions.[19]

The basic technology used in ADT alerts can also be used for the implementation of other care management health IT strategies such as improved tracking of high-risk patients, better population health, support of new care delivery models and identification of high utilizers of health care services. [17,19]

Technological Requirements for an ADT System

In order to establish a well-functioning ADT alert system, the following components are necessary[17]:

1.) Access to data through established connections with data trading partners who may send, receive, or transfer the ADT message information.
2.) A Master Patient Index (MPI): A MPI is necessary in order to cross-reference incoming ADT messages to existing patient information to verify that alerts are sent out for the appropriate patient.
3.) Guidelines for receipt of alerts: ADT alert systems require a directory or database that includes a list of authorized care providers or care coordinators who can receive alerts and specifies when a specific patient alert should be sent.
4.) Secure messaging or transport functionality: data transport functionality is necessary to send alerts from the ADT system to care providers or care coordinators. Examples of data transport functionality include Direct, file transfer protocol (FTP), or Virtual Private Network (VPN).

Privacy and Operational Considerations

Due to the fact that ADT alerts include protected health information (PHI) there has been a great deal of discussion regarding whether or not it is necessary to obtain informed consent from patients prior to sending their information through an ADT alert system. Privacy laws and policies vary by state and some HIE or health care entities have chosen to obtain informed consent whereas others have not.[17] Organizations who have chosen not to obtain informed consent are encouraged to send patients a notice informing them about the alert system and providing them with an opportunity to opt-out of the ADT alert program.[17]

In addition to privacy concerns, there are many operational issues that must be addressed prior to the implementation of an ADT alert system. The first is to determine which patients are eligible to be part of the alert system. Some organizations may want to receive notifications for only certain patients whereas others will want to be notified of activity for their entire patient population. The second issue is to decide which individual on the care team should receive the alert message – for example, messages can be sent to a care coordinator or manager or directly to a patient's physician.[17] The third consideration is to determine how the information will be sent. There are several options such as: a proprietary clinical messaging tool, Secure File Transfer Protocol (SFTP), Direct protocols, PDF, comma-separated values (CSV) file or Health Level Seven (HL7) standards.[17] The fourth component that should be considered is what information should be sent in the alert. The information included in an alert can range from basic to complex - such as the inclusion of a discharge summary with results from lab or radiology tests.[17] Lastly, organizations should decide how they would like to address ADTs for patients that are not listed in the MPI.

Examples of ADT Systems Implemented Across the Country

In the past several years, communities all over the United States have begun to implement ADT alert programs. ADT alert programs have been implemented in 8 out of 17 of the Beacon Communities established by the ONC.[69] NORC at the University of Chicago (NORC) conducted an evaluation of all the Beacon Communities and found that due to the fact that most hospital health IT systems already produce ADT data to track patient transitions in their own systems, ADT alerts systems provide useful information to providers using existing infrastructure.[69] In addition, some of these Beacon Communities, such as Western New York,

support care transitions by creating interfaces for communication with long term care organizations, rehabilitation organizations and home care agencies.[16]

At the Greater Cincinnati Beacon Community, care coordinators based at primary care sites use ADT alerts to monitor, connect and evaluate asthmatic children in the hospital and then follow-up with them at the clinic if necessary.[70] A case study of the program at Greater Cincinnati reported that practices found alerts provided by the community-wide HIE were seen as a valuable addition to quality improvement efforts.[71]

CRISP Encounter Notification System

The Chesapeake Regional Information System for our Patients, or CRISP, is the health information exchange in Maryland and Washington, D.C. CRISP was created under the HITECH Act's Health IT Program and was incorporated in 2009 as a not-for-profit membership organization with the intention of building a statewide HIE in Maryland.[72] CRISP's founding organizations include Johns Hopkins Medicine, MedStar Health, the University of Maryland Medical System and Erickson Retirement Communities, and operates under the direction of the Maryland Health Care Commission (MHCC).[73] The MHCC received a $9.3 million State Health Information Exchange Cooperative Agreement Award to implement the statewide HIE through CRISP.[73,74] In addition, the ONC designated CRISP the Maryland Regional Extension Center for Health IT and provided the organization with $5.5 million to help the 1,000 PCPs in Maryland deploy EHRs.[73-75] In 2010, CRISP went live with the Maryland HIE and through the HIE, CRISP has developed a number of services to help care providers in Maryland advance the health and wellness of their patients. These HIE services include: an Integrated Care Network (ICN), the Prescription Drug Monitoring Program (PDMP), DIRECT Messaging, the CRISP Portal, and the ADT alert system called the Encounter Notification Service.[76]

In partnership with Audacious Inquiry, a health IT and health policy company, CRISP implemented its own ADT alert program called Encounter Notification Service (ENS). CRISP went live with ENS in August 2012 and as of 2015 was sending hospital utilization and patient demographic data from all 48 hospitals in the Maryland to about 560 care practices, the majority of which are ambulatory care sites.[17,77]

Similar to other ADT alert programs, ENS is a tool that will inform care providers and care coordinators whenever a patient in their practice has had an ED encounter or is admitted to or discharged from a hopsital.[17,59] Some ADT programs rely on patients to provide information about their provider of record when they visit the ED or hospital, which often results in missing or inaccurate physician contact information.[78] ENS addresses the issue of inaccurate or incomplete physician contact information by asking physicians and care coordinators to select patients about whom they want to receive ADT alerts and submit them to CRISP via "patient panels." These patient panels are loaded into ENS and a subscription list is generated for each provider.

If a patient visits the ED or hospital, an ENS notification is triggered from automatic ADT messages that originate from the hospital registration system. In order to correctly identify the patient and determine if a participant would like to be notified about that patient's care activity, ENS compares the hospital ADT message to both the CRISP Master Patient Index and the patient panel provided by the participant. If there is a match, an ENS notification is sent to that participant.[17,59] ENS enables accurate and timely transfer of patient information, and through ENS, a care entity can receive real-time, customizable alerts when their patient has a care event.[79] After receiving a notification, care providers at a practice can evaluate if the patient requires follow-up care or care coordination. In addition, the information in the ENS message, as

well as the method and time of delivery, can vary based on participant preferences and can include information such as reason for visit, diagnosis at discharge, location of discharge, and discharge disposition.[59]

Johns Hopkins Community Physicians (JHCP) enrolled in ENS in September 2012 and reported that by using ENS, they have been able to engage in a variety of best practices to reduce readmissions through the following care coordination activities: improved patient transfer between facilities, timely communication during handoff at discharge from hospital, early post-acute follow-up with the PCP, early post-discharge phone calls, and effective medication management.[59] JHCP reported that ENS notifications are a valuable tool shown to improve quality of care, health outcomes and care coordination.[59]

Subscribing to ENS

Subscribing health care organizations that would like to receive ENS notifications subscribe to ENS through CRISP and provide a list of patients that they would like to receive alerts for. These organizations, referred to as participants, include entities such as ambulatory care providers, primary care consortiums, insurance payors, managed care organizations, hospitals, and substance use disorder treatment centers. Typically, ENS participants choose to receive notifications for all patients in their patient panel. In addition, the participant can select the types of events (e.g. inpatient admission, emergency discharge) they would like to receive alerts for as well as the preferred frequency of the notifications (e.g. immediate, daily, weekly). Once a participant has enrolled in ENS, the participant will receive an ENS notification when one of their patients is admitted or discharged from the hospital. Multiple participants, for example an ambulatory care practice and an insurance payor, can receive notifications for the

same patient and patient event.

How ENS functions

Utilizing data on both ENS participants and the notifications themselves, this study will explore: patient characteristics, participant characteristics, and ENS notification characteristics from October 1, 2013 through November 2015. This study will also look at trends in notifications over time.

Data and Methods

The data for this study was provided through Audacious Inquiry and includes information about ENS notifications from October 2013 through November 2015. The data includes more than 9 million notifications and information regarding 565 Participants. The data, and the study, includes information about patients that utilized hospital services during the study period and for whom a notification was sent.

Results

Patient Characteristics

The unit of analysis for patient characteristics is notifications. Some patients may have more notifications sent for a single care event than others - due to both the participant alert preferences and number of participants that have requested that patient's information. The patient characteristics such as gender, age and geography correspond to the notifications that were sent during the study period. Table 4.1 shows that about 61% of notifications were sent for female patients.

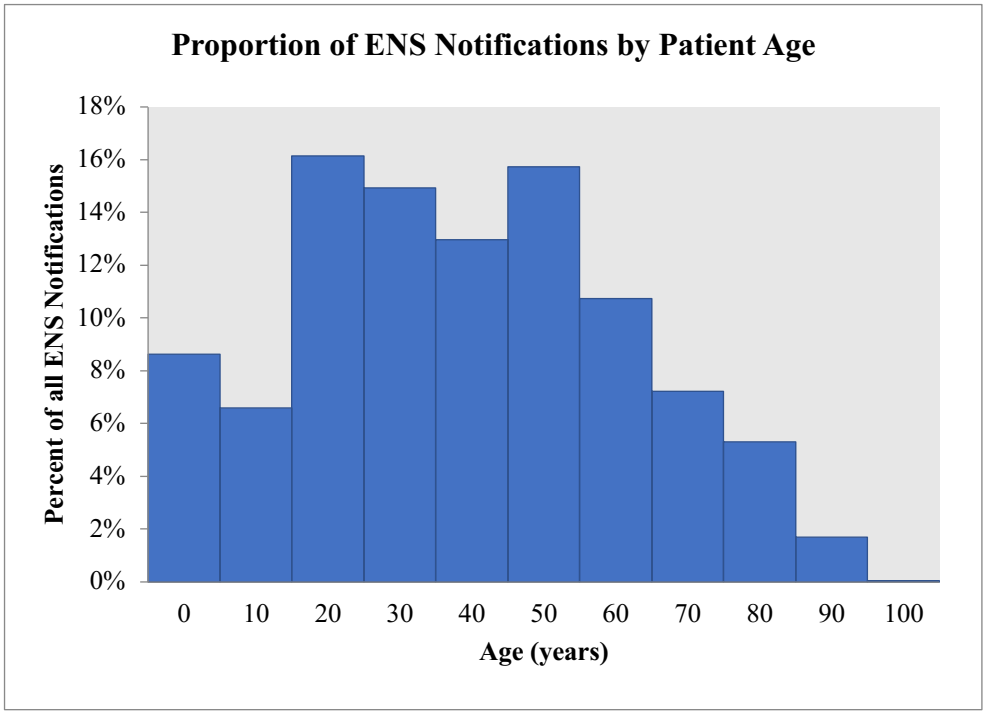
Table 4.1. Proportion of ENS Notifications by Patient Gender

Patient Gender	Percent of Notifications (%)	Frequency of Notifications
Female	60.83	5,705,028
Male	39.17	3,673,323
Total	100.00	9,378,351

*.65% missing (from 9,439,777)

Figure 4.1 below shows the distribution of ENS notifications by patient age – the majority of notifications were sent for patients between the ages of 20 and 60 years old.

Figure 4.1. Distribution of ENS Notifications by Age



*3.98% missing (from 9,439,777)

The proportion of ENS notifications by patient state is shown in Table 4.2, and given that ENS was implemented in Maryland and Washington, D.C., it is understandable that 92.4% of notifications were sent for patients residing in Maryland with almost 7% being sent for patients in the District of Columbia. The table shows that patients from neighboring states also received care in Maryland or Washington, D.C., and were associated with health care entities that

subscribe to ENS.

Table 4.2. Proportion of ENS Notifications by Patient State

Patient State	Percent of Notifications (%)	Number of Notifications
Maryland	92.30	8,597,815
Washington DC	6.68	621,750
Virginia	0.31	28,797
Pennsylvania	0.25	23,479
Other	0.18	16,388
Delaware	0.15	14,275
West Virginia	0.13	12,085
Total	100.00	9,314,589

*1.33% missing (from 9,439,777)
**States with less than .1% of patients were combined

Table 4.3 displays the number and proportion of notifications that were sent by patient region, specifically looking at Maryland and Washington, D.C. (The breakdown of Maryland region by county is available in Appendix A). The majority (about 57%) of notifications were sent for patients who were residents of the Baltimore Region, followed by residents of Suburban Washington (20.8%) and the Eastern shore (7.54%). About 6.72% of notifications were sent for patients who reside in Washington, DC.

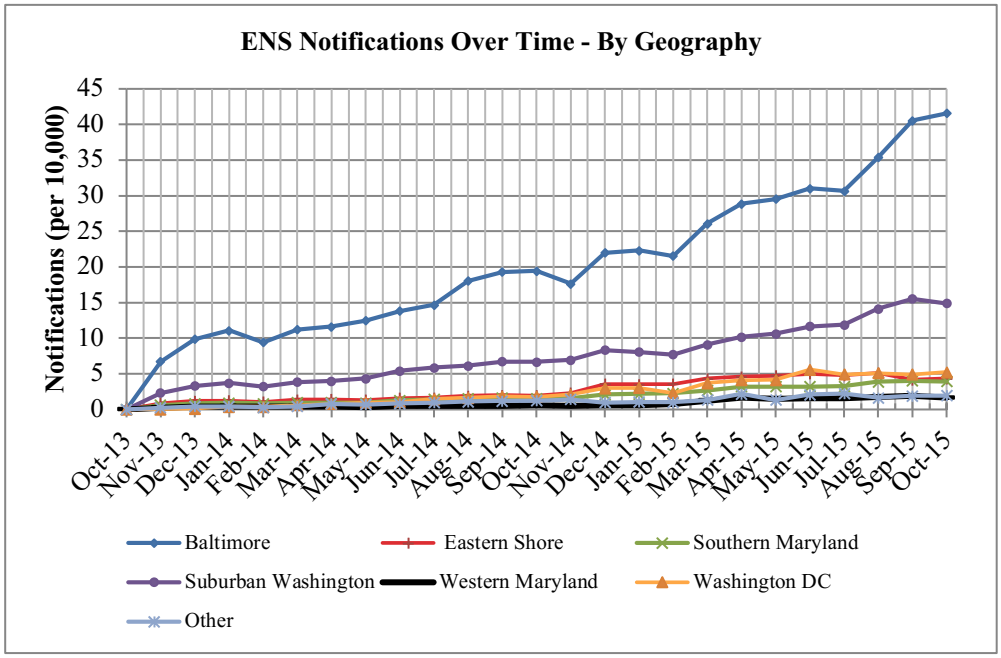
Table 4.3. Proportion of ENS Notifications by Patient region of residence (Maryland and Washington, D.C)

Geographic Region	Percent of Notifications (%)	Number of Notifications	Population Estimate (% of Total MD Population)
Maryland			
Baltimore Region	57.07	5,223,581	2,748,503 (46%)
Suburban Washington	20.80	1,903,607	2,194,973 (37%)
Eastern Shore	7.54	690,529	453,226 (7.5%)
Southern Maryland	5.54	506,766	358,126 (6.0%)
Western Maryland	2.33	213,444	251,573 (4.2%)
Washington DC	6.72	614,898	672,228
Total	100	9,152,825	

*3.0% missing (from 9,439,777)
** The Maryland Regions and population estimates are based on zip code boundary areas provided by the Maryland Department of Planning (July 2015)
***Washington, D.C. population estimate from US Census (July 2015)

Figure 4.2 shows the number of ENS notifications over time by region, based on patient zip code. The greatest numbers of ENS notifications were sent for patients in the Baltimore region and notifications for that area grew consistently over time. The relatively high number of notifications in the Baltimore region may be due to early ENS adoption by participants in that area or the large number of hospitals located in the Baltimore region. The patients in the Suburban Washington area had a large number of notifications, which also grew over the two-year period. Significant use of ENS notifications for patients in the remaining regions occurred later and with a smaller rate of increase, which may be partially due to the population sizes in those regions.

Figure 4.2. Distribution of ENS Notifications over time by Patient Region of Residence



The ENS notifications data was merged with the 2014 American Community Survey (ACS) Census Data in order to determine potential patient income and race/ethnicity information. For Table 4.4, only the second year of the data was used to account for regional

variation that may have been due to differences in initial ENS adoption rates. The demographic information includes percent below 100% federal poverty level, between 100%-200% federal poverty level and above 200% federal poverty level. The race/ethnicity categories include White (non-Hispanic), Black (non-Hispanic), Hispanic and Other. It is important to note that the proportions within region are based on the number of notifications by zip code and not the distribution of unique patients.

Table 4.4. Patient Demographic Characteristics by Region, based on Patient residence

Mean value by Zip code	Baltimore Region	Suburban Washington	Eastern Shore	Southern Maryland	Western Maryland	Washington DC
Below 100% FPL	15.83%	8.57%	14.77%	7.53%	15.82%	21.60%
Between 100%-200% FPL	16.72%	13.36%	17.62%	10.34%	19.83%	16.21%
Above 200% FPL	67.45%	78.08%	67.61%	82.12%	64.35%	62.19%
White, Non-Hispanic	48.13%	32.31%	72.73%	68.98%	84.44%	22.24%
Black, Non-Hispanic	40.27%	39.17%	19.18%	21.47%	8.87%	64.41%
Hispanic	4.90%	17.00%	4.22%	4.00%	3.08%	8.89%
Other	6.70%	11.52%	3.86%	5.55%	3.61%	4.46%

*Based on 2014 ACS Census data and proportion of ENS notifications from patient zip code
**Includes data from October 2014 to October 2015
***FPL (Federal Poverty Level)

Participant Characteristics

A variety of health care organizations may enroll in ENS and receive notifications for their panel of patients. The participants that subscribe to ENS range from individual physicians to large practice consortiums or health insurers. For smaller practices, physicians may directly receive notifications. Larger care organizations may have notifications sent to a coordinator to distribute the alerts internally. Table 4.5 displays the number of participants, per type, that received notifications during the study period. Table 4.8 in the subsequent section displays the proportion of notifications that are sent to each type of participant.

Table 4.5 shows that many different types of outpatient providers have subscribed to ENS, from individual ambulatory care practices to large accountable care organizations (ACOs). A small number of health entities such as a radiology center and local health departments have also subscribed to receive ENS notifications. The notification preferences of these organizations will be discussed in subsequent sections.

Table 4.5. Number and Percentage of Participants Subscribed to ENS

Category of Provider	Participant Type	Percent of Total Participants (%)	Number of Participants
Outpatient Provider			
	Ambulatory Care	65.66	348.0
	Federally Qualified Health Center (FQHC)	5.85	31.0
	Practice Consortium	1.70	9.0
	Accountable Care Organization (ACO)	0.75	4.0
Other Care Provider			
	Hospital	9.81	52.0
	Long Term Care	5.47	29.0
	Mental Health	4.91	26.0
	Home Health Services	1.51	8.0
	Substance Use Disorder Treatment Centers	0.57	3.0
Payor			
	Health Insurer	1.9	10.0
	Managed Care Organization (MCO)	1.1	6.0
Other Health Entity			
	Local Health Department	0.38	2.0
	Radiology Center	0.19	1.0
	Total	100.00	529

*6.37% missing (from 565)

Participant Notification Preferences

Tables 4.6 and 4.7 show participant preferences in terms of alert frequency and types of events (e.g. inpatient admission or emergency discharge) that participants would like to be notified about. Table 4.6 shows that about 78% of participants requested to receive daily notifications with 21% requesting immediate notifications and only 1% of participants requesting to be notified on a weekly basis.

Table 4.6. Participant ENS Alert Frequency preferences

Requested Alert Frequency	Percent of Total Participants (%)	Number of Participants
Immediate	20.95	110.0
Daily	78.10	410.0
Weekly	0.95	5.0
Total	100.00	525.0

*7.08 missing (from 565)

Participants can receive ENS notifications for a variety of care activities or "ADT alert triggers" such as inpatient admission, emergency registration, or transfer of a patient from outpatient to inpatient care. ADT alerts are coded using Health Level Seven (HL7) specifications. Table 4.7 shows the ENS trigger preferences that participants have selected when subscribing to ENS. The majority of participants wish to be notified for inpatient and emergency admissions (A01I and A01E), inpatient and emergency discharges (A031 and A03E) and emergency department registrations (A04E).

Table 4.7. Participant ENS HL7 ADT alert trigger preferences

HL7 ADT alert trigger	Trigger Description	Number of Participants that have requested type of alert
A01I	Inpatient Admission	501
A01E	Emergency Admission	475
A03I	Inpatient Discharge	494
A03E	Emergency Discharge	472
A04E	Emergency Registration	396
A06I	Transfer Outpatient to Inpatient	220
A11I	Cancel Inpatient Admission	79
A11E	Cancel Emergency Admission	79
A13I	Cancel Inpatient Discharge	73
A13E	Cancel Emergency Discharge	18

*6.55% missing (from 565)

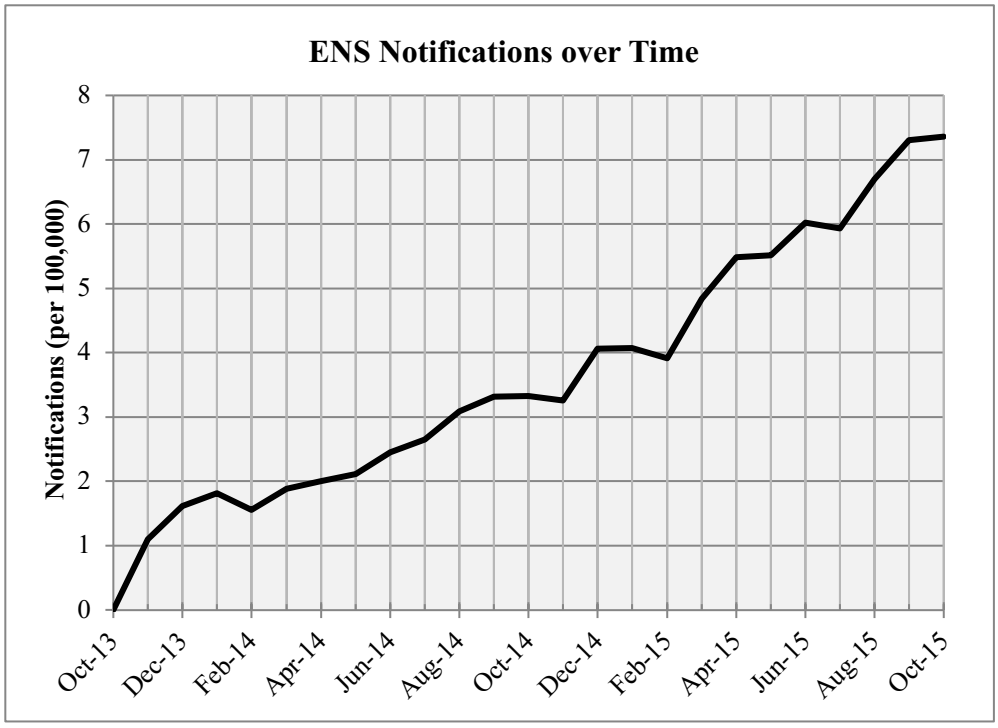
ENS Notification Characteristics

The ENS notifications sent to subscribing participants usually include information such as the patient's personal information, such as name, insurance, attending physician; and may also include additional information such as the patient's diagnosis, lab results, and treatment. This

section will describe the characteristics of the ENS notifications that were sent during the study period.

Figure 4.3 shows that the monthly number of all ENS notifications steadily increased between October 2013 and October 2015. There is a consistent increase in ENS notification, and therefore ENS subscription, during the study period. During October 2015, approximately 800,000 notifications were sent.

Figure 4.3. Distribution of ENS Notifications over time



*3.2% missing (from 9,439,777)

In order to understand where these notifications were being sent, Table 4.8 shows the number of notifications sent to each participant type. During the study period about 40% of notifications were sent to an insurance payor, almost 20% sent to an ambulatory care facility, 10% to managed care organizations, 10% to a hospital, 9% to a federally qualified health center (FQHC) and 6% sent to various practice consortiums. Given that notifications for the same

patient and event can be sent to multiple health care entities, it is possible that notifications are sent to both payors and health care practices – which would account for the large proportion of notifications sent to health insurance payors.

Table 4.8. Distribution of ENS Notifications by Participant Type

Participant Type	Percent of Notifications (%)	Number of Notifications
Insurance Payor	40.74	3,704,667
Ambulatory	19.60	1,782,375
Managed Care Organization	10.24	931,122
Hospital	9.83	893,731
FQHC	9.00	818,330
Practice Consortium	6.00	545,757
Accountable Care Organization	2.59	235,244
Other		
Mental Health	0.87	78,841
Long Term Care	0.46	42,212
Home Health	0.35	31,624
Addiction Treatment Center	0.29	26,056
Local Health Department	0.04	3,265
Radiology Center	0.01	552
Total	100	9,093,776

*3.70% missing (out of 9,439,777 notifications)

Table 4.9 displays the proportion of ENS notifications sent to participant groups (specified in Table 4.5) based on patient region. The Baltimore, Suburban Washington, and Western Maryland regions have a large proportion of notifications sent to the payor category - 47%, 55%, and 69% respectively. Notifications for residents in the Eastern Shore and Southern Maryland regions are divided more evenly between outpatient physician provider account types and payors. In contrast to other regions, patients of the Washington, D.C. region had about 51% of their notifications sent to outpatient care providers, 36% to other care providers and only about 13% sent to the payor group.

Table 4.9. Proportion of ENS Notifications by Patient Geography and Provider Type

Patient Region of Residence	Outpatient Care provider	Other Care provider	Payor	Other Health Entity	Number of Notifications
Baltimore Region	38.46%	14.64%	46.84%	<1.00%	3,643,061
Suburban Washington	31.76%	13.23%	54.95%	<1.00%	1,328,186
Eastern Shore	48.70%	3.32%	47.98%	<1.00%	520,146
Southern Maryland	48.49%	9.06%	42.35%	<1.00%	368,122
Western Maryland	24.18%	7.10%	68.71%	<1.00%	156,566
Washington, D.C.	50.82%	36.43%	12.75%	0.00%	341,633

*Based on proportion of ENS notifications from patient zip code
**Includes data from October 2014 to October 2015

The percent of notifications by visit type are displayed in Table 4.10 which shows that about 74% of total notifications were sent for emergency visits, with the remaining 26% sent for inpatient hospital visits.

Table 4.10. Distribution of ENS Notifications by Visit Type

ENS Visit Type	Percent of Notifications (%)	Frequency of Notifications
Emergency	74.06	6,972,180
Inpatient	25.94	2,441,748
Total	100.00	9,413,928

*.27% missing (from 9,439,777)

Table 4.11 shows that about 73% of ENS notifications are sent daily, 26% are sent immediately and less than one percent are sent on a Weekly basis. This coincides with the ENS participant frequency preferences listed in Table 4.6.

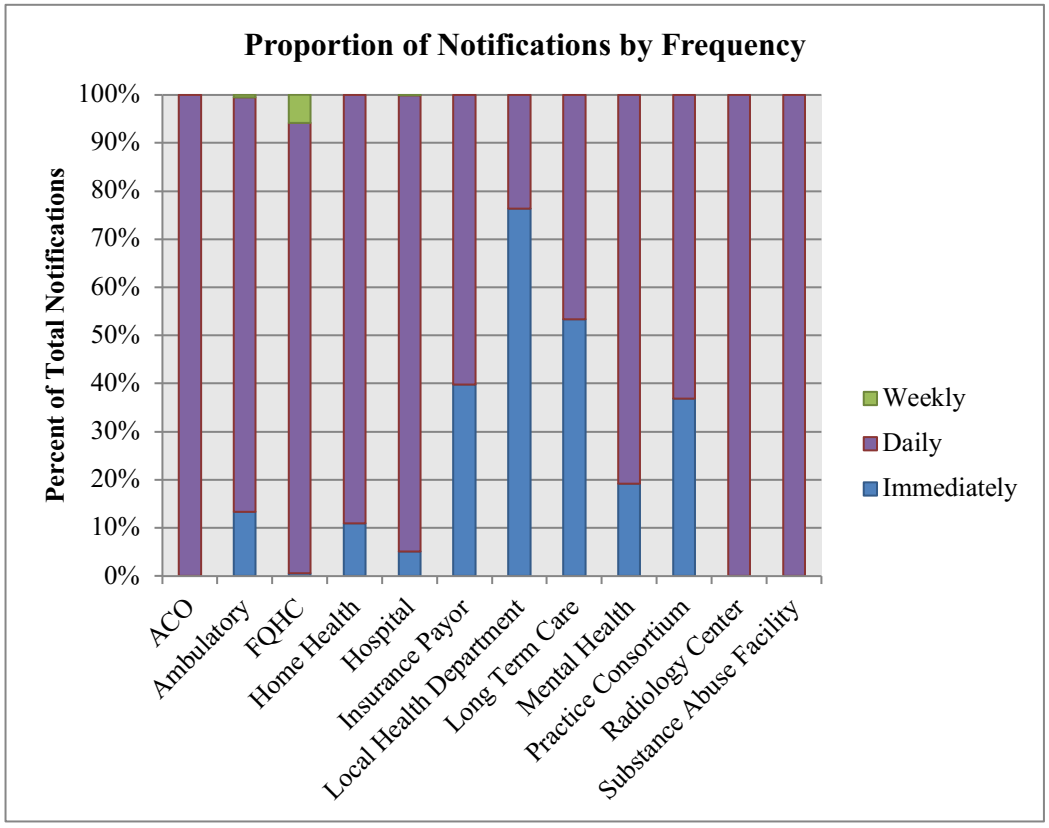
Table 4.11. Distribution of ENS Notification by Frequency

Notification Frequency	Percent of Notifications (%)	Number of Notifications
Immediate	26.25	2,377,383
Daily	73.12	6,622,818
Weekly	0.63	56,966
Total	100	9,057,167

*4.05% missing (from 9,439,777)

Figure 4.4 below displays the frequency of ENS notifications by proportion of total notifications for each account type. More than 50% of the notifications received by local health department and long term care accounts are sent immediately. Generally, insurance payors and practice consortiums accounts received almost 50% and 40% of their notifications immediately, respectively. Subscribing ACOs, the radiology center, MCOs and addiction treatment centers only receive notifications on a daily basis. The only type of account to receive more than 5% of their notifications on a weekly basis is the FQHC. The remaining account types received the vast majority of their notifications on a daily basis.

Figure 4.4. Proportion of ENS Notifications by Frequency, per Account Type



*4.05% missing (from 9,439,777)

As was described earlier, health care entities that subscribe to ENS may receive notifications for a range of activities such as patient admission, transfer or discharge. Table 4.12 shows that the majority of notifications, about 44%, are for a patient discharge, 33% were sent when a patient was registered and almost 15% of total notifications were sent for a patient admission.

Table 4.12. Distribution of ENS Notifications by Event Type

Event Type	Percent of Notifications (%)	Number of Notifications
A01 (Admission)	14.89	1,399,639
A03 (Discharge)	44.37	4,172,118
A04 (Register)	33.05	3,107,185
A06 (Transfer Outpatient to Inpatient)	3.93	369,327
A08 (Update Patient Information)	3.32	312,069
A11 (Cancel Admission)	0.23	21,618
A13 (Cancel Discharge)	0.22	20,863
Total	100.00	9,402,819

*.39% missing (out of 9,439,777 notifications)

Discussion

This study finds that ENS notifications are received by a wide range of care organizations throughout the state of Maryland and in Washington, D.C. including a large number of health insurers and managed care organizations. As was shown in Table 4.5, many different types of outpatient providers have subscribed to ENS, from individual ambulatory care practices to large accountable care organizations (ACOs). By receiving these ENS notifications in a timely manner, outpatient care practices may more quickly follow-up with patients who need additional care – potentially improving care coordination and quality of care. Care coordination is the function that promotes the patient's needs and preferences for health services, and ensures the appropriate and timely sharing of patient information across people, functions, and sites.[80] Individuals often require care coordination beyond the outpatient care site and the fact hospital departments, long term care facilities, mental health services, home health services, and

substance use disorder centers also have subscribed to ENS indicates that care may be coordinated among providers at different levels of care.

Looking at notifications over time, it is clear that ENS has been adopted on a growing rate throughout the study period. Through the analysis of the data, the notification preferences of various account types have also become evident. The majority of ENS subscribing organizations prefers to receive notifications on a daily basis and for care activities such as inpatient and emergency admission and discharge as well as emergency registration.

Limitations

A limitation of this study is that multiple ENS notifications may be sent to numerous entities for the same patient and/or for the same care event, and due to potential changes in participant patient panels, and notification frequency and event preferences, it is difficult to determine how many individual patients and patient events are represented in the data. An additional limitation is that patient demographic information is based on census data by zip code and may not accurately reflect the demographics of the patients for whom notifications are sent.

Conclusion

The findings of this study demonstrate that a wide variety of health organizations in Maryland and Washington, D.C. have adopted ENS, and notifications are sent for patients throughout the various regions of Maryland. Given that both outpatient care providers and hospital other health service organizations are utilizing notifications, ENS has the potential to serve as an important care coordination trigger and can improve the flow of patient information among different care entities. Additional studies could examine: how information in ENS notifications is used by participants, the potential for the information to improve care coordination and quality of care, and further customization of alerts by participant type.

CHAPTER FIVE: CONCLUSION

This dissertation examined two programs in Maryland. The first, the Health Enterprise Zone (HEZ) Initiative provides resources for underserved communities in Maryland to increase access to care and improve health outcomes. The second, the CRISP Encounter Notification Service (ENS) is a type of health IT that serves as a care coordination trigger with the potential to improve care transitions and patient outcomes.

Summary of Findings:

Aim 1: HEZ Initiative activities were associated with a decrease in inpatient utilization for disease and diabetes, but an increase in inpatient utilization for asthma, pediatric asthma, substance use disorders and depression and emergency department visits for pediatric asthma. The impact of the intervention may take longer to reduce utilization for those conditions, or that health education and screening increased the decision for residents with those conditions to seek care in an inpatient setting.

Aim 2: The HEZ Initiative is associated with a decrease in inpatient stays and an increase in emergency department visits for Medicaid enrollees. Programs such as HEZ may reduce potentially avoidable inpatient care utilization for Medicaid enrollees.

Aim 3: The CRISP Encounter Notification Service (ENS) was adopted by a wide range of care organizations throughout the state of Maryland and in Washington, D.C. ENS was adopted at a growing rate during the study period and was adopted by a variety of outpatient care providers, health service organizations.

Policy Implications:

HEZ Initiative

The factors that contribute to an individual's health and quality of life are not isolated to a particular setting – they are multifaceted and interdependent. Therefore, efforts to improve health outcomes and quality of care should also be collaborative and multidisciplinary. The Accountable Health Care Communities and other programs make it clear that community based interventions such as HEZ can improve health outcomes for populations in underserved communities. Both analyses of the HEZ intervention, the first for all patients in the HEZ and HEZ Eligible zip codes and the second specifically for patients enrolled in Medicaid, demonstrated that HEZ is associated with a decrease in certain types of inpatient utilization. Given the high cost of inpatient care, programs such as HEZ may have an impact on potentially avoidable inpatient utilization – reducing health care costs and improving the health of a population.

CRISP ENS

The findings of this study demonstrate that a wide variety of health organizations in Maryland and Washington, D.C. have adopted ENS, and notifications are sent for patients throughout the various regions of Maryland. Given that both outpatient care providers and hospital other health service organizations are utilizing notifications, ENS has the potential to serve as an important care coordination trigger and can improve the flow of patient information among different care entities.

Priorities for Future Research

HEZ Initiative

The impact of programs such as HEZ may take many years to be fully reflected by the health outcomes of communities. Therefore, future studies could examine changes in health outcomes five to ten years after implementation. In addition, examining changes in ambulatory care utilization or preventive health could also reflect how HEZ activities impacted care use in setting other than the hospital or emergency department. Given the findings of the HEZ studies, a future study could examine why the HEZ was associated with a decrease in inpatient stays for certain conditions but an increase in ED utilization.

In addition, HEZ complements the insurance expansion of the Affordable Care Act by connecting providers to community and social services at the exact time that a large number of uninsured individuals gained access to affordable health insurance. A study specifically examining the associated changes in hospital utilization for the expanded Medicaid population could provide information on how resources provided by HEZ are used by this group.

CRISP ENS

Future studies on Admission, discharge and transfer alert programs such as ENS could include a qualitative study to examine how participants use ADT alerts across a variety of types of health organizations. Secondly, future research should examine if health IT such as ENS are associated with improved care coordination or health outcomes. Evaluating the impact of ENS on care coordination could be conducted by looking at the association between ENS adoption and reimbursement for care coordination activities – such as claims for transitional care management services or evaluation and management outpatient office visits for the Medicare population. To measure the impact of potential care coordination activities triggered by ENS, a

study could examine the association between ENS adoption and a reduction in 30-day readmissions for conditions that are sensitive to ambulatory care and improved care coordination.

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Education

Johns Hopkins Bloomberg School of Public Health 2018
Doctor of Philosophy (PhD), Health Policy and Management
Track: Health Services Research and Policy

University of California, Los Angeles, School of Public Health 2011
Master of Public Health (MPH), Community Health Sciences

University of California, Berkeley, College of Letters and Sciences 2007
Bachelor of Arts (BA), International Development Studies

Experience

Research Assistant 2014 – 2018
Health Enterprise Zone Initiative (HEZ) Evaluation – Statewide Initiative
Johns Hopkins University – Baltimore, MD

- Analyzed quantitative, longitudinal Maryland inpatient hospital and emergency department discharge data using Stata and SAS
- Worked with a team of researchers to draft evaluation reports and a manuscript on study findings
- Developed questionnaires for qualitative study
- Participated in site visits with HEZ grantees
- Worked with client – the Maryland Department of Health – to obtain data and prepare interim reports

Research Assistant 2016 – 2018
ENS Adoption and Utilization Project – Health Information Technology
Johns Hopkins University – Baltimore, MD

- Designed and led a study on the adoption and use of the CRISP Encounter Notification Service (ENS) – a messaging system implemented through the Maryland health information exchange
- Worked with client – Audacious Inquiry (a health IT and policy company) – on study design
- Analyzed quantitative ENS notification data using Stata and SAS
- Wrote the report on the Utilization of ENS in Maryland and Washington, D.C.

Research Assistant 2014 – 2015
ACHIEVE Intervention and Health Homes Project
Johns Hopkins University – Baltimore, MD

- Conducted a qualitative analysis of interviews with ACHIEVE intervention participants to assess participant experience in a tailored weight loss program

- Worked with a team of researchers to draft manuscript of qualitative study – published in a peer-reviewed journal in 2016

Program Associate 2010 –2013
Community Partners – Los Angeles, CA

- Managed six Los Angeles County Department of Health Services (LACDHS) Specialty-Primary Care Workgroups – comprised of specialists and primary care physicians
- Facilitated meetings, teleconferences, and webinars for the Specialty-Primary Care Workgroup
- Designed and administered surveys on access to specialty care services, diagnostic procedures, and referral practices
- Provided technical assistance to the Specialty Care Initiative (SCI) grantees
- Collaborated with SCI grant funders – Kaiser Permanente Community Benefit and the California Healthcare Foundation – to determine the best way to support grantees
- Worked on the planning, coordination, and implementation of program content and curriculum for the Specialty Care Initiative and Building Clinic Capacity for Quality convenings
- Worked with the Chief Operating Officer of the LACDHS on the development of a more effective specialty care delivery system

Instructional Experience

Teaching Assistant
Johns Hopkins University School of Public Health

- Quality of Medical Care 2014-2015
- Public Health Policy 2015
- Introduction to the US Health Care System 2015-2016
- Patient Safety and Medical Errors 2016
- Fundamentals of Health Policy and Management 2017

Professional Affiliations

- Academy Health, 2013- Present
- Association for Public Policy & Management, 2017-Present

Awards and Honors

- Agency for Healthcare Research and Quality (AHRQ) National Research Service Award (NRSA) Pre-doctoral Research Trainee (2013-2016)
- Charles D. Flagle Scholarship (2015)
- Health Resources and Service Administration (HRSA) Trainee Fellow (2015)

Publications

- **Vazin R**, McGinty EE, Dickerson F, Dalcin A, Goldsholl S, Oefinger Enriquez M, et al. Perceptions of strategies for successful weight loss in persons with serious mental illness participating in a behavioral weight loss intervention: A qualitative study. *Psychiatr Rehabil J.* 2016; 39:137-46.

Articles Under Review

- Gaskin, DJ, **Vazin, R,** McCleary, RR, Thorpe, Jr., RJ. Impact of Multicomponent Community-Based Interventions on Hospital Utilization – the Maryland Health Enterprise Zone Initiative.

- Gaskin, DJ, Zare, H, **Vazin, R**, Love, D, Steinwachs, D. Racial and Ethnic Composition of Hospitals' Service Areas and the Likelihood of Being Penalized for Excess Readmissions by the Medicare Program.

Conference Posters/Presentations

Vazin, R. (2017, November). *Utilization of the CRISP Encounter Notification Service in Maryland and Washington, DC*. Poster Presentation at the 2017 Association for Public Policy Analysis and Management (APPAM) Fall Research Conference, Chicago, IL.

Vazin, R. (2017, June). *Penalties Under the Hospital Readmission Reduction Program: Race, Ethnicity and Social Risk Factors.* Podium Presentation at the 2017 Academy Health Annual Research Conference Interest Group meeting, New Orleans, LA.

Vazin, R. (2017, June). *Utilization of the CRISP Encounter Notification Service in Maryland and Washington, DC*. Poster Presentation at the 2017 Academy Health Annual Research Conference Interest Group meeting, New Orleans, LA.